PQVPLRPMTYKAAVDLSHFL

QUERY	PQVPLRPMTYKAAVDLSHFL
CONSENSUS_A	----------g-f------
A.FR.HIV232956	---------F-G-L------
A.FR.HIV232957	---------F-G-F---F--
A.FR.HIV232959	---------F-G-F---F--
A.KE.Q23-CXC-CG	----------G--------
A.SE.SE6594	--------------------
A.SE.SE7253	-H---------G-L------
A.SE.SE7535	----------G-L------
A.SE.SE8131	----------G-L------
A.SE.SE8538	----------G-F------
A.SE.SE8891	----------G--------
A.UG.92UG037	----------F--GF--
A.UG.U455	----------F---F--
CONSENSUS_B	--------------------
B.-.E90NEF	----------G--------
B.-.HIV232997	----------L------
B.-.HIV233002	----------L------
B.-.HIV233009	----------G-L------
B.-.HIV233016	-K---------V---M----
B.-.HIV233020	--------------------
B.-.HIV233023	--I-----------------
B.-.HIV233029	----------G-L------
B.-.HIV233030	----------G--------
B.-.HIV233032	----------G--------
B.-.HIV233037	----------G-L------
B.-.HIV233038	--------------------
B.-.HIV233043	----------G--------
B.-.HIV233045	----------G-L------
B.-.HIV233046	----------G-L------
B.AU.1062-1-NEF	--------------------
B.AU.93JW-3	----------------P--
B.AU.93LW-3	--------------------
B.AU.AF064660	----------G-F--N---
B.AU.AF064667	---------FR---------
B.AU.AF064676	----------L-I----
B.AU.MBC200	--------------------
B.AU.MBC925	--------------------
B.CN.AF033570	----------G-L------
B.CN.AF033572	----------G-L--N---
B.CN.PRC8	---------F---L------
B.CN.RL42	----------G-L------
B.DE.D31	--------------------
B.DE.HAN	----------G-L------
B.DE.HEI28CS	---------x-G-x------
B.DE.HEI3BL	----------G-L------
B.DE.HEI4BL	--------------------
B.DE.HIVU52491	----------G-L------
B.DE.NEFCC	---------SR--R------
B.DE.NEFCG	---x-------G-L------
B.DE.NH53	--------------------
B.ES.89SP061	----------G-L------
B.ES.AF082355	--------------------
B.ES.AF082357	----------G-L------
B.ES.AF082358	----------G-L------
B.ES.AF082359	--------------F----
B.ES.AF082363	----------M-I----
B.ES.AF082364	--------------------
B.ES.AF082366	----------G-L------
B.ES.AF082368	----------G-L------
B.ES.AF082370	----------G--------
B.ES.AF082375	----------F---F--
B.ES.AF082376	----------G--------
B.ES.AF082377	--------------------
B.ES.AF082378	--------------------
B.ES.AF082380	--------------------
B.ES.AF082383	----------G-F------
B.ES.AF082386	--------------------
B.FR.HIV232961	--------------------
B.FR.HIV232962	----------G--------
B.FR.HIV232963	---------F-G-L------
B.FR.HIV232964	--------S----L------
B.FR.HIV232965	--------------------
B.FR.HXB2	--------------------
B.FR.NE100	---------RR--I------
B.FR.SWB884	---------RR--I------
B.GA.OYI	----------G-L------
B.GB.001GH-93(1)	----------G-M------
B.GB.002EM-93(1)	----------G-LN-----
B.GB.003PW-93(1)	-------I-----L------
B.GB.005PF1-93(1)	--------------------
B.GB.006DC-93(1)	----------G-F------
B.GB.010JW-93(1)	----------G-L------
B.GB.011JR-93(4)	----------G-L------
B.GB.012WM-93(1)	------------F------
B.GB.013PP-94(2)	--I-------Q--L------
B.GB.016GB-93(1)	----V-----R--R-F----
B.GB.023PA-93(1)	L------------F------
B.GB.025JN-93(1)	----------G-F---Y--
B.GB.027SL-93(1)	--------------------
B.GB.028JH-94(1)	----------G-L------
B.GB.030JG-93(1)	----------L------
B.GB.031DA-93(1)	----V------G-L------
B.GB.032AN-93(1)	----------R--L------
B.GB.037BS-94(2)	----------R---------
B.GB.039NM-94(1)	--I--------G-L------
B.GB.044C1-94(2)	----------G--------
B.GB.046JM-94(1)	----------L------
B.GB.048AD-94(1)	----------G-L------
B.GB.056RP-94B(1)	--------I--G-F------
B.GB.057DR-94(1)	----------G--------
B.GB.065RK-94(1)	--------------------
B.GB.067MM-94(2)	----------G-F---Y--
B.GB.068JB-94(1)	L-------------------
B.GB.098MS-94(1)	--------------------
B.GB.103CD-94(1)	----------G-L------
B.GB.104RT-94(1)	----------G--------
B.GB.105AS-94(1)	----------G-L--T---
B.GB.112CR-94(2)	--------I--G-L------
B.GB.117CH-94(2)	--------------------
B.GB.122PS-95(1)	----------G-L------
B.GB.124PD-95(1)	--------------------
B.GB.127RG-96(1)	--------D--G--------
B.GB.130WDC-95(1)	--------------L------
B.GB.131MVS-95(1)	---------------I----
B.GB.143PL-95(1)	-H----------L------
B.GB.151DH-95(1)	--------------------
B.GB.157GT-95(1)	--------N--G--------
B.GB.160KO-95(1)	--------------------
B.GB.161KC-95(1)	----------G-L------
B.GB.162BB-95(1)	--------------------
B.GB.163NG-95(1)	-------I--R--L------
B.GB.164SZ-95(1)	----------G-I------
B.GB.165DH-95(1)	----------G-L------
B.GB.166PW-95(1)	----------G-L------
B.GB.167RW-95(1)	---------F-G-L------
B.GB.168MB-95(1)	----------G--------
B.GB.CAM1	-------------L-I----
B.GB.GLNEF1	--------------------
B.GB.MANC	---------F-G-L------
B.GB.NEF2	----V---------------
B.GB.NEF3	--------------------
B.GB.NEF5	--------------------
B.IN.HIVP35A	----------G-L------
B.IT.AF011471	--E-----------------
B.IT.AF011474	----------G-F------
B.IT.AF011477	----------RG-L------
B.IT.AF011478	----------RGxL------
B.IT.AF011480	-----x--------------
B.IT.AF011482	T------------L------
B.IT.AF011483	----------G-L------
B.IT.AF011486	----------Q--L------
B.IT.AF011488	x---------R--R------
B.IT.AF011492	----------G-L------
B.IT.AF047080	----------S--------
B.IT.AF047081	----------G--------
B.IT.B.IT-L1	--------x----L------
B.IT.B.IT-L2	--------------------
B.IT.B.IT-L3	---------HR--I------
B.IT.B.IT-L4	---------------M----
B.IT.B.IT-L5	---x-------S-----x--
B.IT.B.IT-R1	-------------L------
B.IT.B.IT-R2	----------G-L------
B.IT.B.IT-R3	----------Q--xN-----
B.IT.B.IT-R4	----------G--------
B.IT.B.IT-R5	-------x-CR--I------
B.KR.AF063915	----------G-L------
B.KR.AF063916	--------------------
B.KR.AF063919	----------G-F------
B.KR.AF063921	-------------------I
B.KR.AF063926	----------G-L------
B.KR.AF063927	--------------------
B.KR.AF063931	-------------L------
B.KR.HIVZ98019	--------------------
B.KR.HIVZ98022	----------G--------
B.KR.HIVZ98024	----------G-L------
B.KR.HIVZ98025	--------------------
B.KR.HIVZ98027	----------G-L------
B.KR.HIVZ98029	----------G-L------
B.KR.HIVZ98030	------------S-------

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B.KR.HIVZ98032        -----------G-S------
B.KR.HIVZ98034        --------D--SS-------
B.NL.3202A21          -----------G-L------
B.NL.NEFA             ------------L------
B.NL.NEFD             -----------G-L------
B.NL.NEFE             ------------F------
B.SE.AF047082         ------------L------
B.SE.AF047083         -----------G--------
B.SE.AF047085         ------------F------
B.TH.28-19            -----------G-L------
B.TH.AF082838         -----------G-L------
B.TH.AF082839         --------------------
B.TH.AF082841         ------------F------
B.TW.LM49             --------D--G-I------
B.US.HIV1U03375       -----------G-L------
B.US.005PF-96(1)      --------------------
B.US.AD-93(1)         -----------G-L------
B.US.AD8              --------------------
B.US.BC               -------I-------I----
B.US.BIB              -----------G-R---W--
B.US.BJ-93(1)         --------------------
B.US.BO1              --------------------
B.US.BRVA             --------------------
B.US.BT-94(1)         -R------------------
B.US.CD1              --------------------
B.US.D8511            -----------G-L------
B.US.DH1              -----------G-L------
B.US.DH123            --I----------L------
B.US.DJ-93(1)         --------------------
B.US.E1               -----------G-L------
B.US.E81NEF           -----------G--------
B.US.E88NEF           -----------G--------
B.US.EP-94(1)         ---------W---L------
B.US.FA-93(1)         -----------G--------
B.US.HIV1U16893       ------------L------
B.US.HIV1U24455       -----------G--------
B.US.HIV1U26074       --------------------
B.US.HIV1U26098       --------------------
B.US.HIV1U26112       -----------G-L------
B.US.HIV1U26119       --------------------
B.US.HIV1U26141       --------------------
B.US.HIVU44444        ---------------I----
B.US.HIVU44450        -----------G-L------
B.US.HIVU44456        -----------G--------
B.US.HIVU44465        -----------G-L------
B.US.HIVU44468        --------------------
B.US.HP87B1           -----------G-L------
B.US.HS-93(1)         ------------L------
B.US.JRCSF            ------------I------
B.US.JRFL             -----------G--------
B.US.LM1              -----------G-L------
B.US.LT-87-1(1)       -----------G-L------
B.US.MB-94(1)         -------V---G--------
B.US.MNCG             ------------L------
B.US.NC7              ------------GI------
B.US.NEF              --------------------
B.US.NEF164B          ------------I-M-----
B.US.NEF166E          -----------G-L------

B.US.NEF179C          -----------G-L------
B.US.NEF226B          -------V------------
B.US.P102A13          --------------------
B.US.P233A17          -----------G-L------
B.US.P248A01          --------------------
B.US.P357A01          -----------G-L------
B.US.P896             --------------------
B.US.PC-93(1)         -----------G--------
B.US.PRISO(1)         -H------------------
B.US.RF               ---------F----------
B.US.RP12             --------------------
B.US.RR1              --------------------
B.US.SC               --------------------
B.US.SF2              -------------L-I----
B.US.U16917           --------S------I----
B.US.WEAU160          -------------H-----#
B.US.WR27             --------------------
B.US.YU2              ---------H---M------

CONSENSUS_C           -----------g-f---f--
C.BR.92BR025          ------------V----F--
C.BW.96BW01B21        -----------G-F--GF--
C.BW.96BW0402         ----------------F---
C.BW.96BW0502         -----------G-F--GF--
C.BW.96BW1104         -------------FG--F--
C.BW.96BW1210         -----------G-F---F--
C.BW.96BW15B03        -----------G-----F--
C.BW.96BW16B01        -----------E-F---F--
C.BW.96BW17A09        -------------F---F--
C.ET.ETH2220          -------------F---L--
C.FR.HIV232966        ---------F-G-F---F--
C.FR.HIV232967        ---------F-G-F--GF--
C.FR.HIV232968        --------S----F---F--
C.FR.HIV232969        --------S--S-F---F--
C.FR.HIV232970        --------S----F---F--
C.FR.HIV232971        -------------F--GF--
C.FR.HIV232972        -------------F-FGF--
C.FR.HIV232973        ----------------W--
C.FR.HIV232976        -------------F---F--
C.FR.HIV232977        ----------------W--
C.FR.HIV232978        -------------F---F--
C.FR.HIV232979        -----------G-F---F--
C.FR.HIV232980        ----------------F--
C.FR.HIV232996        -----------G-F---F--
C.IN.21068            ---------F-G-L---F--
C.IN.301904           ---------F-E-----F--
C.IN.301999           ---------F-G-F---F--
C.IN.94IN11246        ---------F-G-F---F--
C.IN.HIVY15117        -----------G-F---F--
C.IN.HIVY17884        ---------F-G-F---F--
C.IN.HIVY17891        ---------F-G-F---F--
C.IN.HIVY17892        ---------F-G-F---F--

CONSENSUS_D           -----------e--------
D.CD.84ZR085          --------------------
D.CD.ELI              -----------E-L------
D.CD.NDK              -----------E--------
D.UG.94UG1141         -----------E--------

CONSENSUS_F           --------------------
F.CM.HIV232985        --------------------
F.CM.HIV232986        -------------L------
F.FR.HIV232987        ---------F----------

CONSENSUS_F1          -----------?--------
F1.BE.VI850           ----V---------------
F1.BR.93BR020.1       -----------G--------
F1.FI.FIN9363         -----------G-F---Q-x
F1.FR.MP411           ---------F----------

CONSENSUS_F2          -------------?------
F2.CM.MP255           --------------------
F2.CM.MP257           -------------L------

CONSENSUS_G           -------------f---F--
G.BE.DRCBL            -------------F---F--
G.FI.HH8793           ----V--------F---F--
G.ML.HIV232990        -------------L---F--
G.NG.92NG083          -------------F---F--
G.NG.HIV232991        --L--------G-F---F--
G.NG.HIV232992        -----------G-F---F--
G.SE.SE6165           ---------F-G-F---F--

CONSENSUS_H           -----------g-f------
H.BE.VI991            -----------G-F------
H.BE.VI997            -------------L------
H.CD.HIV232994        -----------E-F-F-F--
H.CD.HIV232995        ----V------G-L-F----
H.CF.90CF056          -----------G-F------

CONSENSUS_J           --?--------G-?---F--
J.SE.SE9173           --x--------G-F---F--
J.SE.SE9280           --I--------G-----F--

CONSENSUS_K           ---------?-?-F--GF--
K.CD.EQTB11C          ---------F-G-F--GF--
K.CM.MP535            -------------F--GF--
N.CM.YBF30            -------I---Q-F---F--

CONSENSUS_O           ---------?-?-F---F--
O.CM.ANT70C           -----------G-F---F--
O.CM.MVP5180          ---------F---F---F--
CRF01_AE.CF.90CF402   -----------G-F---F--
CRF01_AE.FR.232982    -----------G-F---F--
CRF01_AE.FR.232983    -----------G-F---F--
CRF01_AE.FR.232984    ---------F-E-F---F--
CRF01_AE.TH.1-2       ---------F-E-F---F--
CRF01_AE.TH.1-3       ---------F-E-F---F--
CRF01_AE.TH.11-25     -H-------F-G-F---F--
CRF01_AE.TH.11-31     ---------F-G-F---F--
CRF01_AE.TH.122-21    -----------G-F---F--
CRF01_AE.TH.18-47     -------------F---F--
CRF01_AE.TH.235-3     -----------G-F---F--
CRF01_AE.TH.235-32    -----------G-F---F--
CRF01_AE.TH.24-54     -----------G-F---F-F
CRF01_AE.TH.240-12    -----------G-F-F-F--
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CRF01_AE.TH.26-3      -----------G-F---F--
CRF01_AE.TH.35-6      -----------G-F---F--
CRF01_AE.TH.6-9       -----------G-F---F--
CRF01_AE.TH.73-44     ---------F-G-F---F--
CRF01_AE.TH.74-26     -------------F---F--
CRF01_AE.TH.89-30     ---------F-G-F---F--
CRF01_AE.TH.9-3       -----------G-F---F--
CRF01_AE.TH.93TH253   -----------G-F---F--
CRF01_AE.TH.98-4      -----------G-F---F--
CRF01_AE.TH.CM240     -----------G-F---F--
CRF01_AE.TH.TH022     -----------G-F---F--
CRF01_AE.TH.TH047     ---------F-E-F---F--
CRF02_AG.FR.DJ263     -------------F--GF--
CRF02_AG.FR.DJ264     -----------G-F--GF--
CRF02_AG.NG.IBNG      -----------G--------
CRF03_AB.RU.KAL1532   -----------G-F------
CRF04_cpx.CY.94CY03   ---------F-G-L------
CRF04_cpx.GR.97PVCH   ---------F---L------
CRF04_cpx.GR.97PVMY   --------------------
AC.IN.21301           -----------G-L---F--
AC.RW.92RW009         -----------------F--
AC.SE.SE9488          -----------G-L------
AC.ZM.ZAM184          -----------G--------
ACD.SE.SE8603         -----------------F--
AD.SE.SE6954          -----------G--------
AD.SE.SE7108          --------------------
ADHU.NO.NOGIL3        --------------------
ADU.CD.MAL            -----------G-F------
AF.GA.HIV232981       -----------G-F------
AG.NG.G3              Q-----------F---F--
AG.SE.SE7812          --------------------
AGHU.GA.VI354         --L------F-G-F--GF--
AGJ.AU.BFP90          ----V--------F---F--
AGJ.ML.95ML84         ---------F-G-F---F--
AGU.CD.Z321           ---------F-G-F---F--
BF.BR.93BR029.4       -----------G-L------
DF.BE.VI961           ---------F-G-L------
GH.GA.HIV232993       -----------G-F--GF--
GU.FR.HIV232974       -----------G-F------
U.CD.VI1126           -----------G-F-----I
U.CM.HIV232988        -------------F--GF--
U.FR.HIV232958        -----------G-F--GF--
U.FR.HIV232960        -----------G-F--GF--

CONSENSUS_CPZ         ----?------?-F--??--
CPZ.GA.CPZGAB         ----T--------F------
CPZ.US.CPZUS          -----------Q-F--GF--
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GELDRWEKIRLRPGGKKKYK

QUERY	GELDRWEKIRLRPGGKKKYK
CONSENSUS_A	-k--a----------r
A.KE.Q23-CXC-CG	-KF-A----------R
A.SE.SE6594	-K--A----------R
A.SE.SE7253	-K--A----------R
A.SE.SE7535	-K--A----------Q-R
A.SE.SE8131	-K--A----------N---R
A.SE.SE8538	-R--A----------R
A.SE.SE8891	EKK-A---M----------
A.UG.92UG037	-K--A----------R
A.UG.U455	KK--S----------N---R
CONSENSUS_B	--------------------
B.AU.AF128998	-K--K----------T-Q
B.-.NL43E9	----K----------L--
B.AU.MBC18	-K----------
B.AU.MBC200	----------Q-R
B.AU.MBC925	-------R-----R-----Q
B.AU.MBCC54	----------Q
B.AU.MBCC98	----------Q
B.AU.MBCD36	E----------R---Q
B.CN.RL42	-Q----------R
B.DE.D31	----------R
B.DE.HAN	----K----------Q
B.ES.89SP061	-G----------R
B.FR.HXB2	--------------------
B.GA.OYI	----K----------Q
B.GB.CAM1	----K----------
B.GB.MANC	-K----------
B.JP.JH31	--------------------
B.NL.3202A21	----K----------R--
B.TW.LM49	----K--RV----------R
B.US.85WCIPR54	----------
B.US.AD8	-K----------
B.US.BC	-K--K----------
B.US.DH123	-K--S----------
B.US.JRCSF	----------R
B.US.JRFL	-K--K----------R
B.US.MNCG	-------N----------
B.US.NC7	-D----------M
B.US.NY5CG	----K----------Q-R
B.US.P896	--------------------
B.US.RF	-K--K--------R---R--
B.US.SF2	----K----------
B.US.WC001	----------
B.US.WEAU160	----------N----
B.US.WR27	----K----------R
B.US.YU2	----K----------Q-R
CONSENSUS_C	-K--k----------h-m
C.BR.92BR025	-K--A--R-K-K-----H-M
C.BW.96BW01B22	-K--Q----------C-M
C.BW.96BW0402	-K--A----------Q-R
C.BW.96BW0502	EK--K----------H-M
C.BW.96BW1104	-K--T----------R-M
C.BW.96BW1210	EK--T----------R-M
C.BW.96BW15B03	EK--T-----S------C-M
C.BW.96BW1626	-K--K----------R-M
C.BW.96BW17A09	-K--T----------H-M
C.ET.ETH2220	EK--A----K-------H-M
C.IN.93IN904	EK--K----------H-M
C.IN.93IN905	-K--K----------H-M
C.IN.93IN999	EK--K--R---------H-M
C.IN.94IN11246	-K--K----------H-M
C.IN.95IN21068	-K--K----------R-M
CONSENSUS_D	-K--a----------r
D.CD.84ZR085	-K--A----------
D.CD.ELI	-K--K----------R
D.CD.NDK	-K--T--R----------A
D.CD.Z2Z6	-K--A----------R
D.UG.94UG1141	-K--E----------R
CONSENSUS_F	-K--A----------r
F.BR.BZ162	-K--A----------R
F.CD.VI174	-K--A----Q---------R
F.RW.VI69	-K--A----------R----
CONSENSUS_F1	-K--a----------r
F1.BE.VI850	-K--E----Q-------R--
F1.BR.93BR020.1	-K--A----------R
F1.FI.FIN9363	-K--A----------Q-R
F1.FR.MP411	-K--A--R----------R
CONSENSUS_F2	-K--A------?-----?-R
F2.CM.MP255	-K--A------K-----R-R
F2.CM.MP257	-K--A----------R
CONSENSUS_G	-K--A----------x---x
G.BE.DRCBL	-K--A----------R-R
G.FI.HH8793	-K--A----------R
G.NG.92NG083	-K--S----------R----
G.SE.SE6165	-K--A----------R-S--
CONSENSUS_H	-K--A----------R
H.BE.VI991	-K--A----------R---R
H.BE.VI997	-R--TL----------R
H.CF.90CF056	-K--A----------R
CONSENSUS_J	-K--D----------?-R
J.SE.SE9173	-K--D----------Q-R
J.SE.SE9280	-K--D----------R
CONSENSUS_K	-K--?----------r
K.BE.VI325	-K--T----------S---R
K.CD.EQTB11C	-K--K----Q---------R
K.CM.MP535	-K--A----------
N.CM.YBF30	-K--Q--S-Y---------R
CONSENSUS_O	SK--A--?---?--S--?-R
O.CM.ANT70C	SK--A--Q---K--S----R
O.CM.MVP5180	SK--A--R------S--A-R
CRF01-AE.CF.90CF40	-K--A----------Q-R
CRF01-AE.TH.93TH25	-K--A----------
CRF01-AE.TH.CM240	-K--A----------R---R
CRF01-AE.TH.TH022	-K--A----------R---R
CRF01-AE.TH.TH047	-K--A----------R---H
CRF02_AG.FR.DJ263	-K--S----------R
CRF02_AG.FR.DJ264	-K--S--------A-----R
CRF02_AG.NG.IBNG	-K--A----------R
CRF03_AB.RU.KAL15	-K--A----------E--R
CRF04_cpx.CY.94CY0	-K--A--R----------R
CRF04_cpx.GR.97PVC	-K--A--R----------R
CRF04_cpx.GR.97PVM	-R--A----------R-R
AC.ET.E3099G	-K--T----------N---R
AC.IN.21301	-K--K----------H-M
AC.RW.92RW009	-K--A----K-K-----T-M
AC.SE.SE9488	-K--A----------R
AC.ZM.ZAM174-21	-K--T----------S-R-M
AC.ZM.ZAM184	-K--A----------Q-R
AC.ZM.ZAM716-17	-K--A----------Q-R
ACD.SE.SE8603	-K--A----------R
AD.SE.SE6954	ER--E----Q-------R-R
AD.SE.SE7108	-K--A----------R----
ADHU.NO.NOGIL3	-K--K----------Q-R
ADU.CD.MAL	-K--A----------R
AG.NG.G3	-K--A----------R
AG.SE.SE7812	-K--A----------R
AGHU.GA.VI354	-K--A----------Q
AGJ.AU.BFP90	-K--E----------
AGJ.ML.95ML8	-K--E----------R
AGU.CD.Z321	-K--K----------Q--
BF.BR.93BR029.4	----K----------H---R
DF.CD.VI961	-K--A----------R
U.CD.VI1126	-K--S----------R---R
CONSENSUS_CPZ	-k--?----------M
CPZ.CD.CPZANT	EK--T--S----------M
CPZ.GA.CPZGAB	-K------V------R-R-M
CPZ.US.CPZUS	-R--A----------M

LRPGGKKKYKLKHIVWASRE

QUERY	LRPGGKKKYKLKHIVWASRE
CONSENSUS_A	---------r---l------
A.KE.Q23-CXC-CG	---------RM--LI-----
A.SE.SE6594	---------R---L------
A.SE.SE7253	---------RM--L------
A.SE.SE7535	-------Q-R---L------
A.SE.SE8131	-----N---R---L------
A.SE.SE8538	---------RM--L------
A.SE.SE8891	------------M---R--
A.UG.92UG037	---------R---L------
A.UG.U455	-----N---R---L------
CONSENSUS_B	--------------------
B.AU.AF128998	-------T-Q----------
B.-.NL43E9	-------L------I-----
B.AU.MBC18	--------------------
B.AU.MBC200	-------Q-R----------
B.AU.MBC925	---R-----Q----------
B.AU.MBCC54	---------Q----------
B.AU.MBCC98	---------Q----------
B.AU.MBCD36	-----R---Q----------
B.CN.RL42	---------R---L------
B.DE.D31	---------R----------
B.DE.HAN	---------Q----------
B.ES.89SP061	---------R---L------
B.FR.HXB2	--------------------
B.GA.OYI	---------Q----------
B.GB.CAM1	--------------------
B.GB.MANC	--------------------
B.JP.JH31	--------------------
B.NL.3202A21	-------R------------
B.TW.LM49	---------R---L------
B.US.85WCIPR54	--------------------
B.US.AD8	--------------------
B.US.BC	------------L------
B.US.DH123	--------------------
B.US.JRCSF	---------R----------
B.US.JRFL	---------R----------
B.US.MNCG	------------V------
B.US.NC7	---------M----------
B.US.NY5CG	-------Q-R----------
B.US.P896	--------------------
B.US.RF	---R---R------------
B.US.SF2	--------------------
B.US.WC001	--------------------
B.US.WEAU160	-----N--------------
B.US.WR27	---------R---L------
B.US.YU2	-------Q-R----------
CONSENSUS_C	-------h-m---l------
C.BR.92BR025	-K-----H-MM--L------
C.BW.96BW01B22	-------C-M---L------
C.BW.96BW0402	-------Q-RI--L------
C.BW.96BW0502	-------H-M---L------
C.BW.96BW1104	-------R-MI--L------
C.BW.96BW1210	-------R-MM--L------
C.BW.96BW15B03	S------C-M----------
C.BW.96BW1626	-------R-M---L------
C.BW.96BW17A09	-------H-M---L------
C.ET.ETH2220	-------H-M---L---N--
C.IN.93IN904	-------H-M---L------
C.IN.93IN905	-------H-M---L------
C.IN.93IN999	-------H-M---L------
C.IN.94IN11246	-------H-M---L------
C.IN.95IN21068	-------R-M---L------
CONSENSUS_D	---------r---l------
D.CD.84ZR085	--------------------
D.CD.ELI	---------R----------
D.CD.NDK	---------A---LI-----
D.CD.Z2Z6	---------R---L------
D.UG.94UG1141	---------R---L------
CONSENSUS_F	---------rm--L------
F.BR.BZ162	---------R---L------
F.CD.VI174	---------RM--L------
F.RW.VI69	-----R----M--LI-----
CONSENSUS_F1	---------rm--L------
F1.BE.VI850	-------R--M--LI-----
F1.BR.93BR020.1	---------R---L------
F1.FI.FIN9363	-------Q-RI--L------
F1.FR.MP411	---------RM--L------
CONSENSUS_F2	-?-----?-R---?------
F2.CM.MP255	-K-----R-R---L------
F2.CM.MP257	---------R----------
CONSENSUS_G	-----x---xx--L------
G.BE.DRCBL	-------R-RM--L------
G.FI.HH8793	---------R---L------
G.NG.92NG083	-----R--------------
G.SE.SE6165	-----R-S--I--L------
CONSENSUS_H	---------R---L------
H.BE.VI991	-----R---R---L------
H.BE.VI997	---------R----------
H.CF.90CF056	---------R---L------
CONSENSUS_J	-------?-RI--L------
J.SE.SE9173	-------Q-RI--L------
J.SE.SE9280	---------RI--L------
CONSENSUS_K	---------r---L------
K.BE.VI325	-----S---R---L------
K.CD.EQTB11C	---------R---L------
K.CM.MP535	------------L------
N.CM.YBF30	---------RM--L------
CONSENSUS_O	-?--S--?-R---L------
O.CM.ANT70C	-K--S----R---L------
O.CM.MVP5180	----S--A-R---L------
CRF01-AE.CF.90CF40	-------Q-RM--L------
CRF01-AE.TH.93TH25	----------M--L------
CRF01-AE.TH.CM240	-----R---R---L------
CRF01-AE.TH.TH022	-----R---RM--L------
CRF01-AE.TH.TH047	-----R---H----------
CRF02_AG.FR.DJ263	---------R---L------
CRF02_AG.FR.DJ264	---A-----R---L------
CRF02_AG.NG.IBNG	---------R---L------
CRF03_AB.RU.KAL15	------E--RI--L------
CRF04_cpx.CY.94CY0	---------R---L------
CRF04_cpx.GR.97PVC	---------R---L------
CRF04_cpx.GR.97PVM	-------R-RI--LI-----
AC.ET.E3099G	-----N---R---L------
AC.IN.21301	-------H-MI--L------
AC.RW.92RW009	-K-----T-MM--L------
AC.SE.SE9488	---------RM--L------
AC.ZM.ZAM174-21	-----S-R-MI--L------
AC.ZM.ZAM184	-------Q-RM--L------
AC.ZM.ZAM716-17	-------Q-RI--L------
ACD.SE.SE8603	---------R---L------
AD.SE.SE6954	-------R-R----------
AD.SE.SE7108	-----R--------------
ADHU.NO.NOGIL3	-------Q-R---L------
ADU.CD.MAL	---------R---L------
AG.NG.G3	---------RM--L------
AG.SE.SE7812	---------R---L------
AGHU.GA.VI354	----------QI---------
AGJ.AU.BFP90	----------M--L------
AGJ.ML.95ML8	---------RM--L------
AGU.CD.Z321	-------Q------------
BF.BR.93BR029.4	-----H---R----------
DF.CD.VI961	---------R----------
U.CD.VI1126	-----R---R---L------
CONSENSUS_CPZ	---------Mm--L------
CPZ.CD.CPZANT	---------MI--L---RS-
CPZ.GA.CPZGAB	-----R-R-MM--L------
CPZ.US.CPZUS	---------MM--L------

YKTLRAEQASQEVKNWMTET

QUERY	YKTLRAEQASQEVKNWMTET
CONSENSUS_A	F--------t----g-----
A.KE.Q23-CXC-CG	F--F-----T-D------D-
A.SE.SE6594	F-V------T----G-----
A.SE.SE7253	F--------T-D--------
A.SE.SE7535	F----------D--------
A.SE.SE8131	F-A------T----G---D-
A.SE.SE8538	F-A------T----G-----
A.SE.SE8891	F--------T----G-----
A.UG.92UG037	F--------T----G-----
A.UG.U455	F--------T-D--------
CONSENSUS_B	--------------------
B.AU.AF128998	----------D--------
B.-.NL43E9	--------------------
B.AU.MBC18	---------T----------
B.AU.MBC200	--------------------
B.AU.MBC925	----------D--------
B.AU.MBCC54	--------------------
B.AU.MBCC98	--------------------
B.AU.MBCD36	--------------------
B.CN.RL42	----------D--------
B.DE.D31	---------T----------
B.DE.HAN	---------T----------
B.ES.89SP061	--------------------
B.FR.HXB2	--------------------
B.GA.OYI	----------D--------
B.GB.CAM1	--------------------
B.GB.MANC	--------------------
B.JP.JH31	--------------------
B.NL.3202A21	--------------------
B.TW.LM49	-----T-----D--------
B.US.85WCIPR54	--------------------
B.US.AD8	--------------------
B.US.BC	--------------------
B.US.DH123	--------------------
B.US.JRCSF	---------T----------
B.US.JRFL	--------------------
B.US.MNCG	---------------RT---
B.US.NC7	--------------------
B.US.NY5CG	--------------------
B.US.P896	--------------------
B.US.RF	----------D--------
B.US.SF2	----------D--------
B.US.WC001	--------------------
B.US.WEAU160	---------T----------
B.US.WR27	--------------------
B.US.YU2	--------------------
CONSENSUS_C	F--------t-d------d-
C.BR.92BR025	F--------T-D------D-
C.BW.96BW01B22	F--------T-D------D-
C.BW.96BW0402	F-------ST--------D-
C.BW.96BW0502	F--------T-D--------
C.BW.96BW1104	F-------S---------D-
C.BW.96BW1210	F--------T-D------D-
C.BW.96BW15B03	F--------T-D------D-
C.BW.96BW1626	F--------T-D------D-
C.BW.96BW17A09	F--------T-D------D-
C.ET.ETH2220	F--------T-D------D-
C.IN.93IN904	F--------T-D------D-
C.IN.93IN905	F--------T-D------D-
C.IN.93IN999	FR-------T-D------D-
C.IN.94IN11246	F--------T-D------D-
C.IN.95IN21068	F--------T-D--------
CONSENSUS_D	-----------d--------
D.CD.84ZR085	--------------------
D.CD.ELI	-----------D--------
D.CD.NDK	----------D---------
D.CD.Z2Z6	--------------G-----
D.UG.94UG1141	-----------D--------
CONSENSUS_F	F--------T----G---D-
F.BR.BZ162	F--------T----G---D-
F.CD.VI174	F--------T----G---D-
F.RW.VI69	F------E-T----G---D-
CONSENSUS_F1	F--------?----g---d-
F1.BE.VI850	F-V--------D--G---D-
F1.BR.93BR020.1	F--------T----G---D-
F1.FI.FIN9363	F-A------T----G---D-
F1.FR.MP411	F-------------------S
CONSENSUS_F2	F--------T----?-----
F2.CM.MP255	F--------T----------
F2.CM.MP257	F--------T----G-----
CONSENSUS_G	F--------T----G---D-
G.BE.DRCBL	F--------T----S---D-
G.FI.HH8793	F--------T----G---D-
G.NG.92NG083	F--------T----G---D-
G.SE.SE6165	F-C--------D--G---D-
CONSENSUS_H	F--------T-D------D-
H.BE.VI991	FRV------T-D------D-
H.BE.VI997	F--------T--------D-
H.CF.90CF056	F--------T-D--------
CONSENSUS_J	F-A------T-D------D-
J.SE.SE9173	F-A------T-D------D-
J.SE.SE9280	F-A------T-D------D-
CONSENSUS_K	f--------T--------?-
K.BE.VI325	F--------T--------D-
K.CD.EQTB11C	FRV------T----------
K.CM.MP535	F--------T--------D-
N.CM.YBF30	---------T----------
CONSENSUS_O	---------T----------
O.CM.ANT70C	---------T----------
O.CM.MVP5180	---------T----------
CRF01-AE.CF.90CF40	F--------T----------
CRF01-AE.TH.93TH25	--V------T----------
CRF01-AE.TH.CM240	---------T----------
CRF01-AE.TH.TH022	---------T----------
CRF01-AE.TH.TH047	---------T----------
CRF02_AG.FR.DJ263	F--------T-----R----
CRF02_AG.FR.DJ264	F--------T----------
CRF02_AG.NG.IBNG	F--------T----------
CRF03_AB.RU.KAL15	F--------T-D--------
CRF04_cpx.CY.94CY0	F-C------T----------
CRF04_cpx.GR.97PVC	F-C------T----------
CRF04_cpx.GR.97PVM	F-C------T-D--------
AC.ET.E3099G	F-A------T-D--------
AC.IN.21301	F--------T-D------D-
AC.RW.92RW009	F----------D------D-
AC.SE.SE9488	F--------T-D------D-
AC.ZM.ZAM174-21	F--------T--------D-
AC.ZM.ZAM184	F--------T--------D-
AC.ZM.ZAM716-17	F--------T-D------D-
ACD.SE.SE8603	F--------T----------
AD.SE.SE6954	----------RD--------
AD.SE.SE7108	F--------T----G---D-
ADHU.NO.NOGIL3	F--------T--------D-
ADU.CD.MAL	F--------T----------
AG.NG.G3	F--------T--------D-
AG.SE.SE7812	F--------T-D--------
AGHU.GA.VI354	F--------T----------
AGJ.AU.BFP90	F--------T--------D-
AGJ.ML.95ML8	F--------T--------D-
AGU.CD.Z321	F--------T----G---D-
BF.BR.93BR029.4	--------T--D--------
DF.CD.VI961	----------D--------
U.CD.VI1126	F--------T--------D-
CONSENSUS_CPZ	--------------?-----
CPZ.CD.CPZANT	---I-------P--A-----
CPZ.GA.CPZGAB	------------------D-
CPZ.US.CPZUS	----------P---T-----

MFSALSEGATPQDLNTMLNT

QUERY	MFSALSEGATPQDLNTMLNT
CONSENSUS_A	----------m---i
A.KE.Q23-CXC-CG	----------M---I
A.SE.SE6594	----------M---I
A.SE.SE7253	V---------M---I
A.SE.SE7535	----------M---I
A.SE.SE8131	----------H---M---I
A.SE.SE8538	----------I
A.SE.SE8891	----------G---M---I
A.UG.92UG037	----------M---I
A.UG.U455	----------M---V
CONSENSUS_B	----------
B.AU.AF128998	----------
B.-.NL43E9	----------
B.AU.MBC18	----------
B.AU.MBC200	----------
B.AU.MBC925	----------
B.AU.MBCC54	----------
B.AU.MBCC98	----------
B.AU.MBCD36	--T---------
B.CN.RL42	----------
B.DE.D31	----------
B.DE.HAN	----------
B.ES.89SP061	----------
B.FR.HXB2	----------
B.GA.OYI	-----A----------
B.GB.CAM1	----------
B.GB.MANC	---------I----------
B.JP.JH31	----------
B.NL.3202A21	----------
B.TW.LM49	----------
B.US.85WCIPR54	----------
B.US.AD8	----------
B.US.BC	----------
B.US.DH123	----------
B.US.JRCSF	----------
B.US.JRFL	----------
B.US.MNCG	----------
B.US.NC7	----------
B.US.NY5CG	----------
B.US.P896	----------
B.US.RF	----------
B.US.SF2	----------
B.US.WC001	----------
B.US.WEAU160	----------
B.US.WR27	----------Y-----
B.US.YU2	----------
CONSENSUS_C	--T---------
C.BR.92BR025	--T---------
C.BW.96BW01B22	--T---------
C.BW.96BW0402	--T---------
C.BW.96BW0502	--T---------
C.BW.96BW1104	--T----------T-
C.BW.96BW1210	--T---------
C.BW.96BW15B03	--T---------
C.BW.96BW1626	--T---------
C.BW.96BW17A09	--T---------
C.ET.ETH2220	--T---------
C.IN.93IN904	--T---------
C.IN.93IN905	--T---------
C.IN.93IN999	--T---------
C.IN.94IN11246	--T---------
C.IN.95IN21068	--T---------
CONSENSUS_D	----------
D.CD.84ZR085	----------
D.CD.ELI	----------
D.CD.NDK	----------
D.CD.Z2Z6	----------
D.UG.94UG1141	----------
CONSENSUS_F	----------
F.BR.BZ162	----------
F.CD.VI174	----------
F.RW.VI69	----------
CONSENSUS_F1	----------
F1.BE.VI850	----------T--------
F1.BR.93BR020.1	----------
F1.FI.FIN9363	----------
F1.FR.MP411	----------
CONSENSUS_F2	----------
F2.CM.MP255	----------
F2.CM.MP257	----------
CONSENSUS_G	----------xx-
G.BE.DRCBL	--T---------
G.FI.HH8793	----------
G.NG.92NG083	----------
G.SE.SE6165	----------L----
CONSENSUS_H	----------A----
H.BE.VI991	----------A----
H.BE.VI997	----------A----
H.CF.90CF056	----------A----
CONSENSUS_J	----------
J.SE.SE9173	----------
J.SE.SE9280	----------
CONSENSUS_K	----------
K.BE.VI325	-----AD----------
K.CD.EQTB11C	----------
K.CM.MP535	--T---------
N.CM.YBF30	--M--------S--------
CONSENSUS_O	--M------??Y-I-----A
O.CM.ANT70C	--M------ISY-I-----A
O.CM.MVP5180	--M------V-Y-I-----A
CRF01-AE.CF.90CF40	----------M---I
CRF01-AE.TH.93TH25	----------M---I
CRF01-AE.TH.CM240	----------M---I
CRF01-AE.TH.TH022	----------M---I
CRF01-AE.TH.TH047	----------M---I
CRF02_AG.FR.DJ263	--T----------M---I
CRF02_AG.FR.DJ264	--T----------M---I
CRF02_AG.NG.IBNG	----------M---I
CRF03_AB.RU.KAL15	----------M---I
CRF04_cpx.CY.94CY0	----------M---I
CRF04_cpx.GR.97PVC	----------M---I
CRF04_cpx.GR.97PVM	----------M---I
AC.ET.E3099G	----------
AC.IN.21301	--T---------
AC.RW.92RW009	--T---------
AC.SE.SE9488	--T---------
AC.ZM.ZAM174-21	--T---------
AC.ZM.ZAM184	----------
AC.ZM.ZAM716-17	--T---------
ACD.SE.SE8603	----------M---I
AD.SE.SE6954	---------A--------S-
AD.SE.SE7108	----------M---I
ADHU.NO.NOGIL3	------D--------M---I
ADU.CD.MAL	----------M---I
AG.NG.G3	--T---------
AG.SE.SE7812	----------M---I
AGHU.GA.VI354	----------M---I
AGJ.AU.BFP90	--T----------M---I
AGJ.ML.95ML8	----------M---I
AGU.CD.Z321	----------
BF.BR.93BR029.4	----------
DF.CD.VI961	--T---------
U.CD.VI1126	--T---------
CONSENSUS_CPZ	----------v-----A
CPZ.CD.CPZANT	----------H-------A
CPZ.GA.CPZGAB	---------L---V-----A
CPZ.US.CPZUS	--M----------V-----A

DKELYPLTSLRSLFGNDPSSQ

QUERY	DKELYPLTSLRSLFGNDPSSQ
CONSENSUS_A	-r-..qn??PlvSLKSLFGND
A.KE.Q23-CXC-CG	-R-..QAQ.PLVSLKSLFGND
A.SE.SE6594	.TP.....PSVSLKSLFGND
A.SE.SE7253	-R-..QNS.PSVSLKSLFGND
A.SE.SE7535	GQD..-...PLVSLKSLFGND
A.SE.SE8131	.....NNP.PSVSLKSLFGND
A.SE.SE8538	----..QVP.PLVSLKSLFGND
A.SE.SE8891	-R-..SEAPPLISLKSLFGND
A.UG.92UG037	-RD..QNP.PSVSLKSLFGND
A.UG.U455	-R-..QT..PLVSLKSLFGND
CONSENSUS_B	----..ly??PlaSLrsLFgnD
B.AU.AF128998	--D..LY..PLASLKSLFGND
B.-.NL43E9	----..LY..PLASLRSLFG-D
B.AU.MBC18	-RD..SSLYPLASLRSLFGND
B.AU.MBC200	----..LY..PLASLRSLFGND
B.AU.MBC925	E--..LY..PLASLKSLFGND
B.AU.MBCC54	----..LY..PLTSLRSLFGND
B.AU.MBCC98	--D..LY..PLASLISLFGND
B.AU.MBCD36	----..LY..PLASLRSLFGND
B.CN.RL42	----..LY..PLASLKSLFGND
B.DE.D31	----..LY..PLASLRSLFGND
B.DE.HAN	----..LY..PLASLKSLFG-D
B.ES.89SP061	----..LY..PSASLKSLFGND
B.FR.HXB2	----..LY..PLTSLRSLFGND
B.GA.OYI	--G..LY..PLTSLRSLFGND
B.GB.CAM1	----..LY..PLASLRSLFGND
B.GB.MANC	----..LY..PLASLRPLFGND
B.JP.JH31	----..LY..PLASLRSLFGND
B.NL.3202A21	----..LY..PLASLRSLFGND
B.TW.LM49	--D..LY..PLASLESLFGND
B.US.85WCIPR54	----..QY..PLASLRSLFGND
B.US.AD8	----..LY..PLTSLKSLFGND
B.US.BC	----..MY..PLASLRSLFGND
B.US.DH123	.---..LY..PLASLKSLFGND
B.US.JRCSF	----..LY..PLTSLRSLFGND
B.US.JRFL	----..MY..PLTSLRSLFGND
B.US.MNCG	--D..LY..PLASLKSLFGND
B.US.NC7	----..VY..PLTSLRSLFGND
B.US.NY5CG	----..LY..PLASLRSLFG-D
B.US.P896	----..LY..PLASLRSLFGND
B.US.RF	----..LY..PLASLKSLFGND
B.US.SF2	----..LY..PLTSLRSLFGND
B.US.WC001	----..LY..PLASLRSLFGND
B.US.WEAU160	----..LY..PLTSLKSLFGND
B.US.WR27	----..LY..PLASLRSLFVND
B.US.YU2	----..LY..PLASLRSLFG-D
CONSENSUS_C	-r-..????pLtslkSLFG-d
C.BR.92BR025	----..L...PLTSLKSLFG-D
C.BW.96BW01B22	-R-......PLTSLRSLFG-D
C.BW.96BW0402	-R-......PLTSLKSLFG-D
C.BW.96BW0502	-R-..-YREPLTALRSLFG-G
C.BW.96BW1104	-R-......PLISLKSLFG-D
C.BW.96BW1210	-R-..-...PLASLKSLFGND
C.BW.96BW15B03	-R-......PLISLKSLFG-D
C.BW.96BW1626	-R-......PLTSLRSLFGND
C.BW.96BW17A09	REP.......LTS-KSLFG-D
C.ET.ETH2220	-R-......ALTSLKSLFGND
C.IN.93IN904	-R-......PLTSLRSLFG-D
C.IN.93IN905	-R-......PLTSLRSLFG-D
C.IN.93IN999	-R-......PLTSLKSLFG-D
C.IN.94IN11246	ER-......PLTSLRSLFG-D
C.IN.95IN21068	-R-......PLTSLRSLFG-D
CONSENSUS_D	----..Ly?.PltsLKSLFGND
D.CD.84ZR085	----..LY..PLASLKSLFGND
D.CD.ELI	----..L.Y.PLTSLKSLFGND
D.CD.NDK	----..LY..PLASLKSLFGND
D.CD.Z2Z6	----..LY..PSTALKSLFGND
D.UG.94UG1141	----..LY..PLTSLKSLFGND
CONSENSUS_F	?EG..LyP.PLASLKS.....
F.BR.BZ162	EEG..LYP.PLASLKS.....
F.CD.VI174	GEG..LYP.PLASLKS.....
F.RW.VI69	-EG..LSP.PLASLKS.....
CONSENSUS_F1	-eg??lYP.PLASLKSLFGnD
F1.BE.VI850	-G-..LYP.PLASLKSLFGND
F1.BR.93BR020.1	-EG..LYP.PLASLKSLFGND
F1.FI.FIN9363	EEG..QYP.PLASLKSLFGND
F1.FR.MP411	-EGQGLYP.PLASLKSLFG-D
CONSENSUS_F2	??-..Q?P.PL?SLKSLFG-D
F2.CM.MP255	GE-..QAP.PLVSLKSLFG-D
F2.CM.MP257	---..QVP.PLISLKSLFG-D
CONSENSUS_G	E--..LY..PLxSLKSLFG-D
G.BE.DRCBL	E--..LY..PL-SLKSLFGND
G.FI.HH8793	E--..TH..PLASLKSLFG-D
G.NG.92NG083	E--..LY..PLTSLKSLFG-D
G.SE.SE6165	E--.....-YPSLKSLFG-D
CONSENSUS_H	---..-...PLASLRSLFGND
H.BE.VI991	EQ-..-...PLTSLRSLFGND
H.BE.VI997	---..-...PFASLKSLFGND
H.CF.90CF056	---..-...PLASLRSLFG-D
CONSENSUS_J	----..LY..PLTSL?SLFG-D
J.SE.SE9173	----..LY..PLTSLRSLFG-D
J.SE.SE9280	----..LY..PLTSLKSLFG-D
CONSENSUS_K	----..qgp.PLTSLkSlfgnd
K.BE.VI325	----..QGS.PLTSLKS.....
K.CD.EQTB11C	-Q-..QGP.PLTSLKSLFG-D
K.CM.MP535	----..QSP.PLTSLKSLFGND
N.CM.YBF30	ENS..LYP.PLTSLRSLFGND
CONSENSUS_O	??-..LY..PFASLKSLFGTD
O.CM.ANT70C	PN-..LY..PFASLKSLFGTD
O.CM.MVP5180	QE-..LY..PFASLKSLFGTD
CRF01-AE.CF.90CF40	--K..QPP.PLVSLKSLFGND
CRF01-AE.TH.93TH25	----..HPP.PSVSLKSLFGND
CRF01-AE.TH.CM240	----..HPP.PLVSLKSLFGND
CRF01-AE.TH.TH022	----..HPP.PSVSLKSLFGND
CRF01-AE.TH.TH047	----..-PP.PLISLKSLFGND
CRF02_AG.FR.DJ263	-QG..LYP.PLASLKSLFGND
CRF02_AG.FR.DJ264	-QG..LYP.PLASLKSLFGND
CRF02_AG.NG.IBNG	--G..LYP.PLTSLKSLFGND
CRF03_AB.RU.KAL15	-R-..QHP.PSISLKSLFGDD
CRF04_cpx.CY.94CY0	----..LY..PLTSLKSLFG-D
CRF04_cpx.GR.97PVC	----..LY..PLTSLKSLFGNH
CRF04_cpx.GR.97PVM	----..LY..PITSLKSLFG-D
AC.ET.E3099G	--x..LYP.PLxSLKSLFGND
AC.IN.21301	-R-......PLTSLKSLFG-D
AC.RW.92RW009	-R-......PLISLKSLFGND
AC.SE.SE9488	-R-..QGP.PLVSLKSLFGND
AC.ZM.ZAM174-21	-R-......TLTSLRSLFGND
AC.ZM.ZAM184	-R-......PLISLKSLFGND
AC.ZM.ZAM716-17	-R-......PLTSLKSLFGND
ACD.SE.SE8603	----..LY..PLASLKSLFGND
AD.SE.SE6954	----..LY..PLASLKSLFGND
AD.SE.SE7108	NR-..QAP.PLISLKSLFGND
ADHU.NO.NOGIL3	-R-..-PP.PLVSLKSLFGND
ADU.CD.MAL	----..LY..PLASLKSLFGND
AG.NG.G3	E---..S.P.PLTSLKSLFGND
AG.SE.SE7812	--G..LYP.PLASLKSLFGND
AGHU.GA.VI354	E---.RY..PLTSLKSLFG-D
AGJ.AU.BFP90	E-G..LY..PLASLKSLFG-D
AGJ.ML.95ML8	E---..LY..PLASLKSLFGND
AGU.CD.Z321	----..LYP.PLASLKSLFG-D
BF.BR.93BR029.4	----..MY..PLASLRSLFGND
DF.CD.VI961	-EG..KYP.PLASLKSLFGND
U.CD.VI1126	--G..QEP.PLTSLKSLFG-D
CONSENSUS_CPZ	??-..l?pp??tSLKSLFG-D
CPZ.CD.CPZANT	.E-..L.PPS.YSLKSLFGKD
CPZ.GA.CPZGAB	..S..LYPP..TSLKSLFG-D
CPZ.US.CPZUS	E---.F..QLTSLKSLFG-D

Study Subject ID:02RCH19
Study Subject Clone:
Study Subject HLA:A2,A30,B42,B44,Cw5,Cw17
Sequence: Known reactive 20Mer0: PQVPLRPMTYKAAVDLSHFL Nef(72–91)

Possible HLA

A2	A2.1,A*0201,A*0202,A*0203,A*0204,A*0205,A*0206,A*0207,A*0208,A*0209,A*0210,A*0211,A*0212,A*0213,A*0214,A*0216,A*0217,A*0218,A*0220,A*02
A30	A*3001,A*3002,A*3003,A*3004
B42	B*4201,B*4202
B44	B*4402,B*4403,B*4404,B*4405,B*4406,B*4407,B*4408
Cw5	Cw*0501,Cw*0502

Possible Epitopes based on anchor residues

(7-14)	PMTYKAAV	A*0201
(7-16)	PMTYKAAVDL	A*0201
(13-20)	AVDLSHFL	A*0205
(7-16)	PMTYKAAVDL	A*0205
(13-20)	AVDLSHFL	A*0214

Anchor Residues Searched

A*0201	X[LM]XXXXXX[VL]
A*0201	X[LM]XXXXX[VL]
A*0201	X[LM]XXXXXXX[VL]
A*0202	X[L]XXXXXX[LV]
A*0202	X[L]XXXXX[LV]
A*0202	X[L]XXXXXXX[LV]
A*0204	X[L]XXXXXX[L]
A*0204	X[L]XXXXX[L]
A*0204	X[L]XXXXXXX[L]
A*0205	X[VLIMQ]XXXXXX[L]
A*0205	X[VLIMQ]XXXXX[L]
A*0205	X[VLIMQ]XXXXXXX[L]
A*0206	X[V]XXXXXX[V]
A*0206	X[V]XXXXX[V]
A*0206	X[V]XXXXXXX[V]
A*0207	X[L][D]XXXXX[L]
A*0207	X[L][D]XXXX[L]
A*0207	X[L][D]XXXXXX[L]
A*0214	X[VQL]XXXXXX[LV]
A*0214	X[VQL]XXXXX[LV]
A*0214	X[VQL]XXXXXXX[LV]

B44	X[E]XXXXXX[Y]
B44	X[E]XXXXX[Y]
B44	X[E]XXXXXXX[Y]
B*4402	X[E]XXXXXX[FY]
B*4402	X[E]XXXXX[FY]
B*4402	X[E]XXXXXXX[FY]
B*4403	X[E]XXXXXX[YF]
B*4403	X[E]XXXXX[YF]
B*4403	X[E]XXXXXXX[YF]

Study Subject ID:02RCH19
Study Subject Clone:
Study Subject HLA:A2,A30,B42,B44,Cw5,Cw17
Sequence: Known reactive 20Mer1: GELDRWEKIRLRPGGKKKYK p17(11–30)

Possible HLA

A2	A2.1,A*0201,A*0202,A*0203,A*0204,A*0205,A*0206,A*0207,A*0208,A*0209,A*0210,A*0211,A*0212,A*0213,A*0214,A*0216,A*0217,A*0218,A*0220,A*02
A30	A*3001,A*3002,A*3003,A*3004
B42	B*4201,B*4202
B44	B*4402,B*4403,B*4404,B*4405,B*4406,B*4407,B*4408
Cw5	Cw*0501,Cw*0502

Possible Epitopes based on anchor residues

(2-11)	ELDRWEKIRL	A*0201
(2-11)	ELDRWEKIRL	A*0202
(2-11)	ELDRWEKIRL	A*0204
(2-11)	ELDRWEKIRL	A*0205
(2-11)	ELDRWEKIRL	A*0207
(2-11)	ELDRWEKIRL	A*0214

Anchor Residues Searched

A*0201	X[LM]XXXXXX[VL]
A*0201	X[LM]XXXXX[VL]
A*0201	X[LM]XXXXXXX[VL]
A*0202	X[L]XXXXXX[LV]
A*0202	X[L]XXXXX[LV]
A*0202	X[L]XXXXXXX[LV]
A*0204	X[L]XXXXXX[L]
A*0204	X[L]XXXXX[L]
A*0204	X[L]XXXXXXX[L]
A*0205	X[VLIMQ]XXXXXX[L]
A*0205	X[VLIMQ]XXXXX[L]
A*0205	X[VLIMQ]XXXXXXX[L]
A*0206	X[V]XXXXXX[V]
A*0206	X[V]XXXXX[V]
A*0206	X[V]XXXXXXX[V]
A*0207	X[L][D]XXXXX[L]
A*0207	X[L][D]XXXX[L]
A*0207	X[L][D]XXXXXX[L]
A*0214	X[VQL]XXXXXX[LV]
A*0214	X[VQL]XXXXX[LV]

A*0214	X[VQL]XXXXXXX[LV]
B44	X[E]XXXXXX[Y]
B44	X[E]XXXXX[Y]
B44	X[E]XXXXXXX[Y]
B*4402	X[E]XXXXXX[FY]
B*4402	X[E]XXXXX[FY]
B*4402	X[E]XXXXXXX[FY]
B*4403	X[E]XXXXXX[YF]
B*4403	X[E]XXXXX[YF]
B*4403	X[E]XXXXXXX[YF]

Study Subject ID:02RCH19
Study Subject Clone:
Study Subject HLA:A2,A30,B42,B44,Cw5,Cw17
Sequence: Known reactive 20Mer2: LRPGGKKKYKLKHIVWASRE p17(21–40)

Possible HLA

A2	A2.1,A*0201,A*0202,A*0203,A*0204,A*0205,A*0206,A*0207,A*0208,A*0209,A*0210,A*0211,A*0212,A*0213,A*0214,A*0216,A*0217,A*0218,A*0220,A*02
A30	A*3001,A*3002,A*3003,A*3004
B42	B*4201,B*4202
B44	B*4402,B*4403,B*4404,B*4405,B*4406,B*4407,B*4408
Cw5	Cw*0501,Cw*0502

Possible Epitopes based on anchor residues

Anchor Residues Searched

A*0201	X[LM]XXXXXX[VL]
A*0201	X[LM]XXXXX[VL]
A*0201	X[LM]XXXXXXX[VL]
A*0202	X[L]XXXXXX[LV]
A*0202	X[L]XXXXX[LV]
A*0202	X[L]XXXXXXX[LV]
A*0204	X[L]XXXXXX[L]
A*0204	X[L]XXXXX[L]
A*0204	X[L]XXXXXXX[L]
A*0205	X[VLIMQ]XXXXXX[L]
A*0205	X[VLIMQ]XXXXX[L]
A*0205	X[VLIMQ]XXXXXXX[L]
A*0206	X[V]XXXXXX[V]
A*0206	X[V]XXXXX[V]
A*0206	X[V]XXXXXXX[V]
A*0207	X[L][D]XXXXX[L]
A*0207	X[L][D]XXXX[L]
A*0207	X[L][D]XXXXXX[L]
A*0214	X[VQL]XXXXXX[LV]
A*0214	X[VQL]XXXXX[LV]
A*0214	X[VQL]XXXXXXX[LV]
B44	X[E]XXXXXX[Y]
B44	X[E]XXXXX[Y]
B44	X[E]XXXXXXX[Y]
B*4402	X[E]XXXXXX[FY]
B*4402	X[E]XXXXX[FY]

B*4402 X[E]XXXXXXX[FY]
B*4403 X[E]XXXXXX[YF]
B*4403 X[E]XXXXX[YF]
B*4403 X[E]XXXXXXX[YF]

Study Subject ID:02RCH19
Study Subject Clone:
Study Subject HLA:A2,A30,B42,B44,Cw5,Cw17
Sequence: Known reactive 20Mer3: YKTLRAEQASQEVKNWMTET p24(169–188)

Possible HLA

A2	A2.1,A*0201,A*0202,A*0203,A*0204,A*0205,A*0206,A*0207,A*0208,A*0209,A*0210,A*0211,A*0212,A*0213,A*0214,A*0216,A*0217,A*0218,A*0220,A*02
A30	A*3001,A*3002,A*3003,A*3004
B42	B*4201,B*4202
B44	B*4402,B*4403,B*4404,B*4405,B*4406,B*4407,B*4408
Cw5	Cw*0501,Cw*0502

Possible Epitopes based on anchor residues

Anchor Residues Searched

A*0201	X[LM]XXXXXX[VL]
A*0201	X[LM]XXXXX[VL]
A*0201	X[LM]XXXXXXX[VL]
A*0202	X[L]XXXXXX[LV]
A*0202	X[L]XXXXX[LV]
A*0202	X[L]XXXXXXX[LV]
A*0204	X[L]XXXXXX[L]
A*0204	X[L]XXXXX[L]
A*0204	X[L]XXXXXXX[L]
A*0205	X[VLIMQ]XXXXXX[L]
A*0205	X[VLIMQ]XXXXX[L]
A*0205	X[VLIMQ]XXXXXXX[L]
A*0206	X[V]XXXXXX[V]
A*0206	X[V]XXXXX[V]
A*0206	X[V]XXXXXXX[V]
A*0207	X[L][D]XXXXX[L]
A*0207	X[L][D]XXXX[L]
A*0207	X[L][D]XXXXXX[L]
A*0214	X[VQL]XXXXXX[LV]
A*0214	X[VQL]XXXXX[LV]
A*0214	X[VQL]XXXXXXX[LV]
B44	X[E]XXXXXX[Y]
B44	X[E]XXXXX[Y]
B44	X[E]XXXXXXX[Y]
B*4402	X[E]XXXXXX[FY]
B*4402	X[E]XXXXX[FY]

B*4402 X[E]XXXXXXX[FY]
B*4403 X[E]XXXXXX[YF]
B*4403 X[E]XXXXX[YF]
B*4403 X[E]XXXXXXX[YF]

Study Subject ID:02RCH19
Study Subject Clone:
Study Subject HLA:A2,A30,B42,B44,Cw5,Cw17
Sequence: Known reactive 20Mer4: MFSALSEGATPQDLNTMLNT p24(39–58)

Possible HLA

A2	A2.1,A*0201,A*0202,A*0203,A*0204,A*0205,A*0206,A*0207,A*0208,A*0209,A*0210,A*0211,A*0212,A*0213,A*0214,A*0216,A*0217,A*0218,A*0220,A*02
A30	A*3001,A*3002,A*3003,A*3004
B42	B*4201,B*4202
B44	B*4402,B*4403,B*4404,B*4405,B*4406,B*4407,B*4408
Cw5	Cw*0501,Cw*0502

Possible Epitopes based on anchor residues

(10-17)	PQDLNTML	A*0205
(10-17)	PQDLNTML	A*0214

Anchor Residues Searched

A*0201	X[LM]XXXXXX[VL]
A*0201	X[LM]XXXXX[VL]
A*0201	X[LM]XXXXXXX[VL]
A*0202	X[L]XXXXXX[LV]
A*0202	X[L]XXXXX[LV]
A*0202	X[L]XXXXXXX[LV]
A*0204	X[L]XXXXXX[L]
A*0204	X[L]XXXXX[L]
A*0204	X[L]XXXXXXX[L]
A*0205	X[VLIMQ]XXXXXX[L]
A*0205	X[VLIMQ]XXXXX[L]
A*0205	X[VLIMQ]XXXXXXX[L]
A*0206	X[V]XXXXXX[V]
A*0206	X[V]XXXXX[V]
A*0206	X[V]XXXXXXX[V]
A*0207	X[L][D]XXXXX[L]
A*0207	X[L][D]XXXX[L]
A*0207	X[L][D]XXXXXX[L]
A*0214	X[VQL]XXXXXX[LV]
A*0214	X[VQL]XXXXX[LV]
A*0214	X[VQL]XXXXXXX[LV]
B44	X[E]XXXXXX[Y]
B44	X[E]XXXXX[Y]
B44	X[E]XXXXXXX[Y]

B*4402 X[E]XXXXXX[FY]
B*4402 X[E]XXXXX[FY]
B*4402 X[E]XXXXXXX[FY]
B*4403 X[E]XXXXXX[YF]
B*4403 X[E]XXXXX[YF]
B*4403 X[E]XXXXXXX[YF]

Study Subject ID:02RCH19
Study Subject Clone:
Study Subject HLA:A2,A30,B42,B44,Cw5,Cw17
Sequence: Known reactive 20Mer5: DKELYPLTSLRSLFGNDPSSQ p2p7p1p6(117–137)

Possible HLA

A2	A2.1,A*0201,A*0202,A*0203,A*0204,A*0205,A*0206,A*0207,A*0208,A*0209,A*0210,A*0211,A*0212,A*0213,A*0214,A*0216,A*0217,A*0218,A*0220,A*02
A30	A*3001,A*3002,A*3003,A*3004
B42	B*4201,B*4202
B44	B*4402,B*4403,B*4404,B*4405,B*4406,B*4407,B*4408
Cw5	Cw*0501,Cw*0502

Possible Epitopes based on anchor residues

(3-10)	ELYPLTSL	A*0201
(6-13)	PLTSLRSL	A*0201
(3-10)	ELYPLTSL	A*0202
(6-13)	PLTSLRSL	A*0202
(3-10)	ELYPLTSL	A*0204
(6-13)	PLTSLRSL	A*0204
(3-10)	ELYPLTSL	A*0205
(6-13)	PLTSLRSL	A*0205
(3-10)	ELYPLTSL	A*0214
(6-13)	PLTSLRSL	A*0214

Anchor Residues Searched

A*0201	X[LM]XXXXXX[VL]
A*0201	X[LM]XXXXX[VL]
A*0201	X[LM]XXXXXXX[VL]
A*0202	X[L]XXXXXX[LV]
A*0202	X[L]XXXXX[LV]
A*0202	X[L]XXXXXXX[LV]
A*0204	X[L]XXXXXX[L]
A*0204	X[L]XXXXX[L]
A*0204	X[L]XXXXXXX[L]
A*0205	X[VLIMQ]XXXXXX[L]
A*0205	X[VLIMQ]XXXXX[L]
A*0205	X[VLIMQ]XXXXXXX[L]
A*0206	X[V]XXXXXX[V]
A*0206	X[V]XXXXX[V]
A*0206	X[V]XXXXXXX[V]
A*0207	X[L][D]XXXXX[L]

A*0207	X[L][D]XXXX[L]
A*0207	X[L][D]XXXXXX[L]
A*0214	X[VQL]XXXXXX[LV]
A*0214	X[VQL]XXXXX[LV]
A*0214	X[VQL]XXXXXXX[LV]
B44	X[E]XXXXXX[Y]
B44	X[E]XXXXX[Y]
B44	X[E]XXXXXXX[Y]
B*4402	X[E]XXXXXX[FY]
B*4402	X[E]XXXXX[FY]
B*4402	X[E]XXXXXXX[FY]
B*4403	X[E]XXXXXX[YF]
B*4403	X[E]XXXXX[YF]
B*4403	X[E]XXXXXXX[YF]

This table lists epitopes that are experimentally observed to be presented by a HLA type carried by the patient, but the de£ned epitope has substitutions relative to the peptides from your reference strains and so might be missed by your reagents: in HXB2 for Gag, Pol; MN for Env; BRU for Nef, relative to most B clade Sequences in the database:

Protein	Epitope in Database	Epitope in Ref. strain	Epitope in Consensus B	HLA	Notes
p17(77–85)	SLFNTVATL	SLYNTVATL	SLYNTVATL	A*0201	
p24(174–184)	AEQASQDVKNW	AEQASQEVKNW	AEQASQEVKNW	B*4402	
p24(174–184)	AEQASQDVKNW	AEQASQEVKNW	AEQASQEVKNW	B*4402,B44	
RT(179–187)	VIYQYMMDL	VIYQYMDDL	VIYQYMDDL	A2	
RT(179–187)	VIYQYMMDL	VIYQYMDDL	VIYQYMDDL	A2, A*0202	
RT(308–317)	EILKEPVGHV	EILKEPVHGV	EILKEPVHGV	A*0201	
gp160(31–40)	AENLWVTVYY	TEKLWVTVYY	AEQLWVTVYY	B*4402	
gp160(31–40)	AENLWVTVYY	TEKLWVTVYY	AEQLWVTVYY	B44	
gp160(121–129)	KLTPLCVSL	KLTPLCVTL	KLTPLCVTL	A2	
gp160(192–200)	KLTSCNTSV	RLISCNTSV	RLISCNTSV	A2	
gp160(192–200)	TLTSCNTSV	RLISCNTSV	RLISCNTSV	A2	
gp160(192–200)	TLTSCNTSV	RLISCNTSV	RLISCNTSV	A2.1	
gp160(311–320)	RGPGRAFVTI	IGPGRAFYTT	IGPGRAFYTT	A*0201	
gp160(311–320)	RGPGRAFVTI	IGPGRAFYTT	IGPGRAFYTT	A2	
gp160(311–320)	MGPKRAFYAT	IGPGRAFYTT	IGPGRAFYTT	A2	
gp160(369–375)	PEIVTHS	PEIVMHS	PEIVMHS	A2	
gp160(377–387)	NSGGEFFYSNS	NCGGEFFYCNT	NCGGEFFYCNT	A2	
gp160(700–708)	AVLSVVNRV	AVLSIVNRV	AVLSIVNRV	A2	
gp160(704–712)	IVNRNRQGY	IVNRVRQGY	IVNRVRQGY	A*3002	
gp160(747–755)	RLVNGSLAL	RLVHGFLAI	RLVDGFLAL	A2	
gp160(770–778)	RLRDLLLIV	HHRDLLLIA	RLRDLLLIV	A*0201	
gp160(794–802)	KYCWNLLQY	KYWWNLLQY	KYWWNLLQY	A*3002	
gp160(813–822)	SLLNATDIAV	SLLNATAIAV	SLLNATAIAV	A*0201	
gp160(813–822)	SLLNATDIAV	SLLNATAIAV	SLLNATAIAV	A2	
gp160(813–822)	SLLNATDIAV	SLLNATAIAV	SLLNATAIAV	A2.1	
gp160(814–822)	LLNATDIAV	LLNATAIAV	LLNATAIAV	A2	
Nef(136–145)	PLTFGWCFKL	PLTFGWCYKL	PLTFGWCFKL	A2	

Table 1: **p17**

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p17(77–85)	p17(77–85 Clade A)	SLFNTVATL	HIV-1 infection	human(A*0201)	[Dorrell (1999)]
	• Epitope SL9: CTL responses in three individuals with non-clade B infections were studied, 2 with subtype A infections, 1 with subtype C – their infections all originated in East Africa • This epitope is most commonly SLYNTVATL in B subtype, and CTL from the C subtype infection did not recognize B clade gag or the 3Y form of the epitope, but do recognize the predominant A and C clade form, SLFNTVATL				

Table 2: **p24**

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
p24(174–184)	p24(306–316 LAI)	AEQASQDVKNW		human(B*4402)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*4402 epitope				
p24(174–184)	p24(306–316 LAI)	AEQASQDVKNW		human(B*4402,B44)	[Brander & Walker(1997)]
	• Pers. Comm. from D. Lewinsohn to C. Brander and B. Walker, C Brander *et al*., this database, 1999				

Table 3: **RT**

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
RT(179–187)	RT()	VIYQYMMDL	HIV-1 exposure	human(A2)	[Rowland-Jones (1998a)]
	• A CTL response was found in exposed but uninfected prostitutes from Nairobi using previously-de£ned B clade epitopes that tended to be conserved in A and D clades – such cross-reactivity could protect against both A and D and confer protection in Nairobi where both subtypes are circulating • The A and D consensus sequences are both VIYQYMMDL				
RT(179–187)	Pol()	VIYQYMMDL	HIV-1 exposure	human(A2, A*0202)	[Rowland-Jones (1998b)]
	• HIV-speci£c CTL were found in exposed seronegative prostitutes from Nairobi – these CTL may confer protection • Seroprevalence in this cohort is 90-95% and their HIV-1 exposure is among the highest in the world • Most isolated HIV strains are clade A in Nairobi, although clades C and D are also found – B clade epitopes are often cross-reactive, however stronger responses are frequently observed using A or D clade versions of epitopes • This epitope is conserved among A, B and D clade viruses				
RT(308–317)	RT()	EILKEPVGHV	HIV-1 infection	human(A*0201)	[van der Burg (1997), Menendez-Arias (1998)]
	• Recognized by CTL from a long-term survivor, SPIETVPVKL was also recognized • Recognized by CTL from a progressor, EELRQHLLRW and TWETWWTEYW were also recognized				

Table 4: **gp160**

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(31–40)	gp160(30–39 WEAU)	AENLWVTVYY	HIV-1 infection	human(B*4402)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*4402 epitope				
gp160(31–40)	gp160(30–39 WEAU)	AENLWVTVYY	HIV-1 infection	human(B44)	[Borrow (1997), Goulder (1997a), Borrow & Shaw(1998)]
	• Two CTL lines from the patient WEAU were studied – one had an optimal peptide of (A)AENLWVTVYY, and the other (A)AENLWVTVY, and both responded equally well with one or two N-term Alanines • Rapidly post-infection, a strong immunodominant response was observed against this epitope • The naturally occurring forms of the peptide found in WEAU were tested as targets for early WEAU CTLs – the form TENLWVTVY was as reactive as the wild type AENLWVTVY – but the forms AKNLWVTVY, AGNLWVTVY, AANLWVTVY did not serve as targets • The glutamic acid in the second position is a B44 anchor residue • [Goulder (1997a)] and [Borrow & Shaw(1998)] are reviews of immune escape that summarizes this study in the context of CTL escape to £xation				
gp160(121–129)	gp120(121–129)	KLTPLCVSL	*in vitro* stimulation	human(A2)	[Zarling (1999)]
	• This study compares the ability of macrophages and dendritic cells to stimulate primary responses in CD8+ lymphocytes isolated from HLA-appropriate HIV-uninfected donors using peptide-pulsed APC – the dendritic cells performed better as APC for the stimulation of primary responses • Strong CTL responses were elicited by the epitopes DRFYKTLRA and GEIYKRWII when presented by either immature or mature dendritic cells – macrophages were not able to prime a CTL response against DRFYKTLRA • A weak response to KLTPLCVSL was stimulated using macrophages as the APC • No detectable response was observed for the following previously-de£ned HIV epitopes: KIRLRPGGK, ILKEPVHGV, IRLRPGGK, GPKVKQWPL				
gp160(192–200)	gp120(192–199 HXB2R)	KLTSCNTSV	HIV-1 infection	human(A2)	[Brander (1995)]
	• Epitope predicted on HLA binding motif, and studied in the context of inclusion in a synthetic vaccine				
gp160(192–200)	gp120(197–205)	TLTSCNTSV	no CTL shown	human(A2)	[Garboczi (1992)]
	• Crystallization of HLA-A2 molecules complexed with antigenic peptides – refers to Dadaglio *et al* 1991				
gp160(192–200)	gp120(199–207)	TLTSCNTSV	peptide immunization and HIV-1 infection	human(A2.1)	[Brander (1996)]
	• This epitope was recognized by PBMC from 6/14 HIV+ asymptomatic patients • This epitope was used along with pol CTL epitope ALQDSGLEV and a tetanus toxin T helper epitope for a synthetic vaccine • This vaccine failed to induce a CTL response, although a helper response was evident				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(311–320)	gp160(318–327 IIIB)	RGPGRAFVTI	CTL line from HIV-donor	human(A*0201)	[Alexander-Miller (1996)]
	• This immunogenic peptide does not have the known binding motif for A2.1 • The same optimal peptide for this human HLA-A2.1 epitope was observed for a murine H-2 D^d epitope				
gp160(311–320)	gp160(318–327 IIIB)	RGPGRAFVTI	vaccinia IIIB gp160	human(A2)	[Achour (1996)]
	• Individual was immunized with rec vaccinia gp160 IIIB and boosted with puri£ed gp160 • Lysis only occurs with IIIB P18 peptide pulsed onto autologous targets; MN, RF, SIMI P18 peptides fail to stimulate CTL • Restimulating immune cells from gp160 IIIB vaccinees with MN, RF, or SIMI P18 did not enhance the MN, RF, or SIMI speci£c CTL response				
gp160(311–320)	gp160(318–327 SIMI)	MGPKRAFYAT	vaccinia SIMI gp160	human(A2)	[Achour (1996)]
	• Individual was immunized with rec vaccinia gp160 SIMI and boosted with puri£ed recombinant gp160 SIMI • P18 MN and RF peptides were able to stimulate the HIV-speci£c CTL that arose in response to the SIMI vaccination, thus the P18 MN peptide (IGPGRAFYTT) and the P18 RF peptide (KGPGRVIYAT) could cross-react • The P18 IIIB peptide does not cross-react (RGPGRAFVTI in the epitope region) • gp160 SIMI primed immune cells could generate a signi£cantly broader speci£city when stimulated with P18 MN or P18RF peptides, but not P18 IIIB				
gp160(369–375)	gp120(374–380 BRU)	PEIVTHS	HIV-1 infection	human(A2)	[Dadaglio (1991)]
	• De£ned through blocking CTL activity, and Env deletions				
gp160(377–387)	gp120(377–387)	NSGGEFFYSNS		human(A2)	[Hickling (1990)]
	• Peptides recognized by class I restricted CTL can bind to class II				
gp160(700–708)	gp41(705–714)	AVLSVVNRV	HIV-1 infection	human(A2)	[Ferris (1999)]
	• This epitope is processed by a TAP1/2 dependent mechanism				
gp160(704–712)	gp160(704–712 LAI)	IVNRNRQGY		human(A*3002)	[Brander & Goulder(2001), Goulder (2001)]
	• C. Brander notes this is an A*3002 epitope				
gp160(747–755)	gp41(747–755)	RLVNGSLAL	HIV-1 infection	human(A2)	[Parker (1992)]
	• Studied in the context of HLA-A2 peptide binding				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(770–778)	Env(679–777)	RLRDLLLIV	HIV-1 infection	human(A*0201)	[Kmieciak (1998)]
	• CTL responses in six patients to four Env epitopes were studied: D2: LLNATAIAV, 5.3: RLRDLLLIV, D1: KLTPLCVTL, and 4.3: QMHEDIISL – all have A2 anchor residues • The C terminal epitopes (D2 and 5.3) were highly variable and the variability was considered responsible for limited CTL response, while D1 and 4.3, N-terminal epitopes, were much more conserved and gave evidence of high levels of CTL response *in vitro* • Peptides 5.3 and D2 bound to HLA A*0201 with low af£nity and were variable, particularly D2;				
gp160(794–802)	gp160(794–802 LAI)	KYCWNLLQY		human(A*3002)	[Brander & Goulder(2001), Goulder (2001)]
	• C. Brander notes this is an A*3002 epitope				
gp160(813–822)	gp41(814–823 LAI)	SLLNATDIAV	MN rec gp160	human(A*0201)	[Dupuis (1995)]
	• Of two CTL clones, one reacted only with 815-823, the other with 814-823 and 815-823 • Noted to be A*0201 in Brander *et al*., 1999 database				
gp160(813–822)	gp41(814–823)	SLLNATDIAV	HIV-1 infection	human(A2)	[Kundu (1998b)]
	• Allogeneic dendritic cells (DCs) were obtained from HLA-identical siblings, pulsed with rgp160 MN or A2-restricted HIV-1 epitope peptides, and infused monthly into six HIV-infected patients • 1/6 showed increased env-speci£c CTL and increased lymphoproliferative responses, 2/6 showed increase only in proliferative responses, and 3/6 showed no change – pulsed DCs were well tolerated • SLLNATDIAV is a conserved HLA-A2 epitope included in this study – 4/6 patients had this sequence as their HIV direct sequence, and 3 of these had a detectable CTL response – the other two had either the sequence SLFNAIDIAV or SLLNTTDIVV and no detectable CTL response • CTL demonstrated against peptide-coated target, epitope is naturally processed and enhancible with vaccine				
gp160(813–822)	Env(814–823 Clade B)	SLLNATDIAV	HIV-1 MN rgp160	human(A2.1)	[Kundu (1998a)]
	• Ten HIV-1+ HLA A2 asymptomatic individuals were given two courses of HIV-1 MN rgp160 vaccine over a 2 year period • Two hundred and £fty three HIV-1 peptides of 9 or 10 aa possessing the HLA-A2.1 binding motif (Leu at position 2, Val at the C terminus) were identi£ed in gp160, of which 25 had a high or intermediate binding af£nity • Eleven peptides were studied that had high HLA-A2 binding af£nity – a CTL response was detected to 9/11 peptides in at least 1 individual • CTL responses after reimmunization may include recall responses – only individuals with vaccine cross-reactive sequences prior to vaccination showed detectable CTL responses • CTL to overlapping peptides in this region gave a positive response in the greatest number of patients • ALTERNATIVE EPITOPES: LLNATDIAV and LLNATDIAVA – CTL were induced by vaccine in those that had the sequence SLLNATAIAVA in their own infection, but not in those with: NLLNTIAIAVA or NLFNTTAIAVA or SLLNATAITVA				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(814–822)	gp41(815–823 LAI)	LLNATDIAV	MN rec gp160	human(A2)	[Dupuis (1995)]
	• Of two CTL clones, one reacted only with 815-823, the other with 814-823 and 815-823				

Table 5: **Nef**

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(136–145)	Nef(136–145)	PLTFGWCFKL	HIV-1 infection	human(A2)	[Durali (1998)]
	• Cross-clade CTL response was studied by determining the CTL activity in seven patients from Bangui, (6 A subtype, and 1 AG recombinant infections) and one A subtype infection from a person living in France originally from Togo, to different antigens expressed in vaccinia • Pol reactivity: 8/8 had CTL to A subtype, and 7/8 to B subtype, and HIV-2 Pol was not tested • Gag reactivity: 7/8 reacted with A or B subtype gag, 3/8 with HIV-2 Gag • Nef reactivity: 7/8 reacted with A subtype, and 5/8 with B subtype, none with HIV-2 Nef • Env reactivity: 3/8 reacted with A subtype, 1/8 with B subtype, none with HIV-2 Env • Patient B18 had the greatest breadth and diversity of response, and recognized Gag SLYNTVATL and Nef PLTFGWCFKL			

Table 6: **All De£ned Epitopes within the 20mer, regardless of HLA type**

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(72–79)	Nef()	VPLRPMTY	HIV-1 exposed seronegative	human(B35)	[Kaul (2000)]
	• 11/16 heavily HIV exposed but persistently seronegative sex-workers in Nairobi had HIV-speci£c CD8 gamma-IFN responses in the cervix – systemic CD8+ T cell responses tended to be to the same epitopes but at generally lower levels than cervical CD8+ T cell responses • Low risk individuals did not have such CD8+ cells • CD8+ epitopes T cell DTVLEDINL (3 individuals), SLYNVATL (4 individuals), LSPRTLNAW (3 individuals) and YPLTFGWCF (4 individuals) were most commonly recognized by the HIV-resistant women				
Nef(72–79)	Nef()	VPLRPMTY	HIV-1 infection	human(B35)	[Wilson (2000)]
	• Three individuals with highly focused HIV-speci£c CTL responses were studied during acute infection using tetramers – high frequencies of HIV-1-speci£c CD8+ T cells were found prior to seroconversion, and there was a close temporal relationship between the number of circulating HIV-speci£c T cells and viral load was also found • All three patients were B*2705, with HLA alleles: A1, A30/31, B*2705, B35; A1, A*0301, B7, B2705; and A*0201, A*0301, B2705, B39 • ELISPOT was used to test a panel of CTL epitopes that had been de£ned earlier and were appropriate for the HLA haplotypes of the study subjects – 3/3 subjects showed a dominant response to the B*2705 epitope KRWIILGGLNK • The subject with A*0201 had a moderatly strong response to SLYNTVATL • Weak responses were observed to A*301-RLRPGGKKK, A*301-QVPLRPMTYK, and B7-TPGPGVRYPL in the subject who was HLA A1, A*0301, B7, B*2705 • No acute response was detected to the following epitopes: A*201-ILKEPVHGV, A*301-KIRLRPGGK, A*301-AIFQSSMTK, A*301-TVYYGVPVWK, B35-EPIVGAETF, B35-HPDIVIYQY, B35-PPIPVGEIY, B35-NSSKVSQNY, B35-VPLRPMTY, B35-DPNPQEVVL			
Nef(72–91)	Nef(71–90 SF2)	PQVPLRMTYKAAVDLSHFL	HIV-1 infection	human()	[Lieberman (1997a)]
	• Of 25 patients, most had CTL speci£c for more than 1 HIV-1 protein • Eleven subjects had CTL that could recognize vaccinia-expressed LAI Nef • Three of these 11 had CTL response to this peptide • The responding subjects were HLA-A3, A32, B51, B62; HLA-A11, A24, B8, B53				
Nef(72–91)	Nef(71–90 SF2)	PQVPLRPMTYKAAVDLSHFL	HIV-1 infection	human()	[Lieberman (1997b)]
	• CTL expanded *ex vivo* were later infused into HIV-1 infected patients				
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV infection	human()	[Garcia (1997)]
	• The anti-Nef CTL line P1 speci£c for this epitope is able to kill target cells via two mechanisms • First: Ca^{2+}-dependent, perforin-dependent Nef-speci£c lysis • Second: Ca^{2+}-independent, CD95-dependent apoptosis that could also kill non-speci£c targets • Findings indicate that the two mechanisms are not mutually exclusive in human CTL, as they are in mice • CTL mediated CD95-dependent apoptosis may play a role in pathogenesis				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(73–82)	Nef(73–82 NL43)	QVPLRPMTYK	HIV-1 infection	human(A*0301)	[Koenig (1990)]
	• 81 Tyr is critical for binding to A3.1 • C. Brander notes that this is an A*0301 epitope in the 1999 database				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK		human(A*0301)	[Brander & Goulder(2001)]
	• C. Brander notes this is an A*0301 epitope				
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(A11)	[Le Borgne (2000)]
	• Soluble factors in supernatant from both an HIV-speci£c cloned CTL line and an EBV (Epstein-Barr-virus) CTL line inhibit viral replication, but do not block viral entry in CD4+ T lymphocytes, by a noncytotoxic mechanism				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A11)	[Robertson (1993)]
	• Development of a retroviral vector (pNeoNef) to generate autologous CTL targets • [Hunziker (1998)] suggests that HLA-A2 does not in fact present this epitope • The initial assignment of HLA-A2 presentation for this epitope was based on a serological HLA typing. Subsequently, the authors revisited the issue with genetic HLA typing and found that HLA-A11 was the correct presenting molecule (Dr. Florence Buseyne, Pers. Comm., 2000)				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A11)	[Couillin (1994), Goulder (1997a)]
	• Mutational variation in HIV epitopes in individuals with appropriate HLA types can result in evasion of CTL response • [Goulder (1997a)] is a review of immune escape that summarizes this study				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A11)	[Couillin (1995)]
	• Mutations found in this epitope in HLA-A11 positive and negative donors were characterized				
Nef(73–82)	()	QVPLRPMTYK		(A11)	[Brander & Goulder(2001), Buseyne(1999)]
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-infection	human(A3)	[Chassin (1999)]
	• Mutations in Nef that ¤ank this epitope, Thr71Lys and Ala83Gly, may account for an observed loss of CTL reactivity, with escape due to the introduction of proteasome processing defects				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(A3)	[Durali (1998)]
	• Cross-clade CTL response was studied by determining the CTL activity in seven patients from Bangui, (6 A subtype, and 1 AG recombinant infections) and one A subtype infection from a person living in France originally from Togo, to different antigens expressed in vaccinia • Pol reactivity: 8/8 had CTL to A subtype, and 7/8 to B subtype, and HIV-2 Pol was not tested • Gag reactivity: 7/8 reacted with A or B subtype gag, 3/8 with HIV-2 Gag • Nef reactivity: 7/8 reacted with A subtype, and 5/8 with B subtype, none with HIV-2 Nef • Env reactivity: 3/8 reacted with A subtype, 1/8 with B subtype, none with HIV-2 Env • One of the patients was shown to react to this epitope: QVPLRPMTYK			
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A3)	[Goulder (1997b), Goulder (1997a)]
	• Identical twin hemophiliac brothers were both infected with the same batch of factor VIII • Both had a response to this epitope • [Goulder (1997a)] is a review of immune escape that summarizes this study				
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(A3)	[Lubaki (1997)]
	• Eighty two HIV-1-speci£c CTL clones from 5 long-term non-progressors were isolated and analyzed for breadth of response • A sustained Gag, Env and Nef response was observed, and clones were restricted by multiple HLA epitopes, indicating a polyclonal response • An A3+ subject had a strong response to this epitope, with 10/11 CTL clones being speci£c for this epitope, isolated at two time points, 1 year apart				
Nef(73–82)	Nef(73–82 BRU)	QVPLRPMTYK	HIV-1 infection	human(A3, A11, B35)	[Culmann (1991)]
	• Nef CTL clones from HIV+ donors				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A3.1)	[Koenig (1995)]
	• Alanine substitutions L76A, R77A, M79A, T80A signi£cantly decreased immunogenicity of peptide • Nef CTL clones (4N225) were infused into an HIV-1 infected volunteer to evaluate effects of infusion on viral load/patient health • Infusion led to outburst of escape variants which resulted in higher viral load/accelerated disease progression				
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(A3.1)	[Betts (2000)]
	• Only 4/11 HLA-A2+ HIV+ individuals had CTL that reacted to SLYNTVATL, calling into question whether it is immunodominant • Ninty £ve optimally de£ned peptides from this database were used to screen for gamma interferon responses to other epitopes • 1/11 of the A2+ individuals was A3, and responded to QVPLRPMTYK as well as two other A3.1 epitopes				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(B*0301)	[Wilson (2000)]
	• Three individuals with highly focused HIV-speci£c CTL responses were studied during acute infection using tetramers – high frequencies of HIV-1-speci£c CD8+ T cells were found prior to seroconversion, and there was a close temporal relationship between the number of circulating HIV-speci£c T cells and viral load was also found • All three patients were B*2705, with HLA alleles: A1, A30/31, B*2705, B35; A1, A*0301, B7, B2705; and A*0201, A*0301, B2705, B39 • ELISPOT was used to test a panel of CTL epitopes that had been de£ned earlier and were appropriate for the HLA haplotypes of the study subjects – 3/3 subjects showed a dominant response to the B*2705 epitope KRWIILGGLNK • The subject with A*0201 had a moderatly strong response to SLYNTVATL • Weak responses were observed to A*301-RLRPGGKKK, A*301-QVPLRPMTYK, and B7-TPGPGVRYPL in the subject who was HLA A1, A*0301, B7, B*2705 • No acute response was detected to the following epitopes: A*201-ILKEPVHGV, A*301-KIRLRPGGK, A*301-AIFQSSMTK, A*301-TVYYGVPVWK, B35-EPIVGAETF, B35-HPDIVIYQY, B35-PPIPVGEIY, B35-NSSKVSQNY, B35-VPLRPMTY, B35-DPNPQEVVL			
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK		human(B27)	[Culmann(1998)]
	• Optimal epitope mapped by peptide titration				
Nef(73–82)	Nef(73–82 LAI)	SVPLRPMTYK	HIV-1 infection	human(B35 or C4)	[Buseyne (1993)]
	• Vertical transmission of HIV ranges from 13% to 39% • Primary assays showed cytotoxic activity against at least one HIV protein was detected in 70% of infected children • Epitopes recognized in £ve children were mapped using synthetic peptides and secondary cultures • Patient EM13, who had a CTL response to three epitopes in Nef, was infected via blood transfusion after birth and went from CDC stage P2A to P2E during the study				
Nef(74–81)	Nef(74–82)	VPLRPMTY		human(A3)	[Carreno (1992)]
	• Included in HLA-A3 binding peptide competition study				
Nef(74–81)	Nef(73–82 LAI)	VPLRPMTY	HIV-1 or HIV-2 infection	human(B*3501)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*3501 epitope				
Nef(74–81)	Nef(75–82)	VPLRPMTY	no CTL shown	human(B*3501)	[Smith (1996)]
	• Crystal structure of VPLRPMTY-class I B allele HLA-B*3501 complex				
Nef(74–81)	Nef(73–82 LAI)	VPLRPMTY	HIV-1 or HIV-2 infection	human(B35)	[McMichael & Walker(1994), Culmann (1991)]
	• Review of HIV CTL epitopes – de£ned by B35 motif found within a larger peptide				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(74–81)	Nef(73–82 LAI)	VPLRPMTY	HIV-1 or -2 infection	human(B35)	[Rowland-Jones (1995)]
	• VPLRPMTY also recognized by CTL from HIV-2 seropositives; epitope is conserved				
Nef(74–81)	Nef()	VPLRPMTY	HIV-1 exposure	human(B35)	[Rowland-Jones (1998a)]
	• A CTL response was found in exposed but uninfected prostitutes from Nairobi using previously-de£ned B clade epitopes that tended to be conserved in A and D clades – such cross-reactivity could protect against both A and D and confer protection in Nairobi where both subtypes are circulating • The A and D subtype consensus are identical to the B clade epitope				
Nef(74–81)	Nef(75–82)	VPLRPMTY	none	human(B35)	[Lalvani (1997)]
	• A peptide-based protocol was optimized for restimulation of CTLp using optimized peptide and IL-7 concentrations – importantly this protocol does not stimulate a primary response, only secondary – peptide-speci£c CTLp counts could be obtained via staining with peptide-Class I tetramers • This peptide was one of the B35 presented test peptides used in control experiments showing that the assay gave no activity using lymphocytes from 21 healthy B35 seronegative donors				
Nef(74–81)	Nef()	VPLRPMTY	HIV-1 exposure	human(B35)	[Rowland-Jones (1998b)]
	• HIV-speci£c CTL were found in exposed seronegative prostitutes from Nairobi – these CTL may confer protection • Seroprevalence in this cohort is 90-95% and their HIV-1 exposure is among the highest in the world • Most isolated HIV strains are clade A in Nairobi, although clades C and D are also found – B clade epitopes are often cross-reactive, however stronger responses are frequently observed using A or D clade versions of epitopes • This epitope is conserved among A, B, and D clade viruses				
Nef(74–81)	Nef()	VPLRPMTY		human(B35)	[Rowland-Jones (1999)]
	• CTL responses in seronegative highly HIV-exposed African female sex workers in Gambia and Nairobi were studied – these women had no delta 32 deletion in CCR5 • In Gambia there is exposure to both HIV-1 and HIV-2, CTL responses to B35 epitopes in exposed, uninfected women are cross-reactive, • HIV-2 version of this epitope is conserved: VPLRPMTY, and CTLs are cross-reactive – one of £ve B35 CTL epitopes that are cross-reactive, see also [Rowland-Jones (1995)]				
Nef(74–82)	Nef(73–82)	VPLRPMTYK	no CTL shown	human(A11)	[Zhang (1993)]
	• Exploration of A11 binding motif				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(75–82)	Nef(75–82 LAI)	PLRPMTYK	HIV-1 infection	human(A*1101)	[McMichael & Walker(1994)]
	• Review of HIV CTL epitopes • C. Brander notes that this is an A*1101 epitope in the 1999 database				
Nef(75–82)	Nef(75–82 LAI)	PLRPMTYK	HIV-1 infection	human(A*1101)	[Brander & Goulder(2001)]
	• C. Brander notes this is an A*1101 epitope				
Nef(77–85)	Nef(77–85 LAI)	RPMTYKAAL	HIV-1 infection	human(B*0702)	[Bauer (1997)]
	• Structural constraints on the Nef protein may prevent escape • Noted in Brander 1999, this database, to be B*0702				
Nef(77–85)	Nef(77–85 LAI)	RPMTYKAAL	HIV-1 infection	human(B*0702)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*0702 epitope				
Nef(82–91)	Nef(82–91 LAI)	KAAVDLSHFL	HIV-1 infection	human(C*0802)	[Nixon (1999)]
	• A patient who made a mono-speci£c CTL response to this Nef speci£c epitope was given effective anti-retroviral therapy within 90 days of infection, reducing the antigenic stimulous • Within 7 days of therapy, his CTLp frequency dropped from 60 to 4 per million PBMC, as his viremia dropped • The patient went from having an activated effector population (detected by CTLp and clone speci£c RNA) to a non-activated quiescent population (detected by the CTL-clone speci£c DNA)				
Nef(82–91)	Nef(82–91 LAI)	KAAVDLSHFL	HIV-1 infection	human(C*0802(Cw8))	[Brander & Goulder(2001)]
	• C. Brander notes this is a C*0802(Cw8) epitope				
Nef(84–91)	Nef(84–91 LAI)	AVDLSHFL	HIV-1 infection	human(Bw62)	[Culmann-Penciolelli (1994)]
Nef(84–91)	Nef(84–91)	AVDLSHFL	HIV-1 infection	human(Bw62)	[Betts (2000)]
	• Only 4/11 HLA-A2+ HIV+ individuals had CTL that reacted to SLYNTVATL, calling into question whether it is immunodominant • Ninty £ve optimally de£ned peptides from this database were used to screen for gamma interferon responses to other epitopes • 1/11 of the A2+ individuals that didn„t respond to SLYNTVATL reacted with seven other epitopes including this epitope				

Table 7: **All De£ned Epitopes within the 20mer, regardless of HLA type**

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(72–79)	Nef()	VPLRPMTY	HIV-1 exposed seronegative	human(B35)	[Kaul (2000)]
	• 11/16 heavily HIV exposed but persistently seronegative sex-workers in Nairobi had HIV-speci£c CD8 gamma-IFN responses in the cervix – systemic CD8+ T cell responses tended to be to the same epitopes but at generally lower levels than cervical CD8+ T cell responses • Low risk individuals did not have such CD8+ cells • CD8+ epitopes T cell DTVLEDINL (3 individuals), SLYNVATL (4 individuals), LSPRTLNAW (3 individuals) and YPLTFGWCF (4 individuals) were most commonly recognized by the HIV-resistant women				
Nef(72–79)	Nef()	VPLRPMTY	HIV-1 infection	human(B35)	[Wilson (2000)]
	• Three individuals with highly focused HIV-speci£c CTL responses were studied during acute infection using tetramers – high frequencies of HIV-1-speci£c CD8+ T cells were found prior to seroconversion, and there was a close temporal relationship between the number of circulating HIV-speci£c T cells and viral load was also found • All three patients were B*2705, with HLA alleles: A1, A30/31, B*2705, B35; A1, A*0301, B7, B2705; and A*0201, A*0301, B2705, B39 • ELISPOT was used to test a panel of CTL epitopes that had been de£ned earlier and were appropriate for the HLA haplotypes of the study subjects – 3/3 subjects showed a dominant response to the B*2705 epitope KRWIILGGLNK • The subject with A*0201 had a moderatly strong response to SLYNTVATL • Weak responses were observed to A*301-RLRPGGKKK, A*301-QVPLRPMTYK, and B7-TPGPGVRYPL in the subject who was HLA A1, A*0301, B7, B*2705 • No acute response was detected to the following epitopes: A*201-ILKEPVHGV, A*301-KIRLRPGGK, A*301-AIFQSSMTK, A*301-TVYYGVPVWK, B35-EPIVGAETF, B35-HPDIVIYQY, B35-PPIPVGEIY, B35-NSSKVSQNY, B35-VPLRPMTY, B35-DPNPQEVVL			
Nef(72–91)	Nef(71–90 SF2)	PQVPLRMTYKAAVDLSHFL	HIV-1 infection	human()	[Lieberman (1997a)]
	• Of 25 patients, most had CTL speci£c for more than 1 HIV-1 protein • Eleven subjects had CTL that could recognize vaccinia-expressed LAI Nef • Three of these 11 had CTL response to this peptide • The responding subjects were HLA-A3, A32, B51, B62; HLA-A11, A24, B8, B53				
Nef(72–91)	Nef(71–90 SF2)	PQVPLRPMTYKAAVDLSHFL	HIV-1 infection	human()	[Lieberman (1997b)]
	• CTL expanded *ex vivo* were later infused into HIV-1 infected patients				
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV infection	human()	[Garcia (1997)]
	• The anti-Nef CTL line P1 speci£c for this epitope is able to kill target cells via two mechanisms • First: Ca^{2+}-dependent, perforin-dependent Nef-speci£c lysis • Second: Ca^{2+}-independent, CD95-dependent apoptosis that could also kill non-speci£c targets • Findings indicate that the two mechanisms are not mutually exclusive in human CTL, as they are in mice • CTL mediated CD95-dependent apoptosis may play a role in pathogenesis				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(73–82)	Nef(73–82 NL43)	QVPLRPMTYK	HIV-1 infection	human(A*0301)	[Koenig (1990)]
	• 81 Tyr is critical for binding to A3.1 • C. Brander notes that this is an A*0301 epitope in the 1999 database				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK		human(A*0301)	[Brander & Goulder(2001)]
	• C. Brander notes this is an A*0301 epitope				
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(A11)	[Le Borgne (2000)]
	• Soluble factors in supernatant from both an HIV-speci£c cloned CTL line and an EBV (Epstein-Barr-virus) CTL line inhibit viral replication, but do not block viral entry in CD4+ T lymphocytes, by a noncytotoxic mechanism				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A11)	[Robertson (1993)]
	• Development of a retroviral vector (pNeoNef) to generate autologous CTL targets • [Hunziker (1998)] suggests that HLA-A2 does not in fact present this epitope • The initial assignment of HLA-A2 presentation for this epitope was based on a serological HLA typing. Subsequently, the authors revisited the issue with genetic HLA typing and found that HLA-A11 was the correct presenting molecule (Dr. Florence Buseyne, Pers. Comm., 2000)				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A11)	[Couillin (1994), Goulder (1997a)]
	• Mutational variation in HIV epitopes in individuals with appropriate HLA types can result in evasion of CTL response • [Goulder (1997a)] is a review of immune escape that summarizes this study				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A11)	[Couillin (1995)]
	• Mutations found in this epitope in HLA-A11 positive and negative donors were characterized				
Nef(73–82)	()	QVPLRPMTYK		(A11)	[Brander & Goulder(2001), Buseyne(1999)]
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-infection	human(A3)	[Chassin (1999)]
	• Mutations in Nef that ¤ank this epitope, Thr71Lys and Ala83Gly, may account for an observed loss of CTL reactivity, with escape due to the introduction of proteasome processing defects				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(A3)	[Durali (1998)]
	• Cross-clade CTL response was studied by determining the CTL activity in seven patients from Bangui, (6 A subtype, and 1 AG recombinant infections) and one A subtype infection from a person living in France originally from Togo, to different antigens expressed in vaccinia • Pol reactivity: 8/8 had CTL to A subtype, and 7/8 to B subtype, and HIV-2 Pol was not tested • Gag reactivity: 7/8 reacted with A or B subtype gag, 3/8 with HIV-2 Gag • Nef reactivity: 7/8 reacted with A subtype, and 5/8 with B subtype, none with HIV-2 Nef • Env reactivity: 3/8 reacted with A subtype, 1/8 with B subtype, none with HIV-2 Env • One of the patients was shown to react to this epitope: QVPLRPMTYK			
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A3)	[Goulder (1997b), Goulder (1997a)]
	• Identical twin hemophiliac brothers were both infected with the same batch of factor VIII • Both had a response to this epitope • [Goulder (1997a)] is a review of immune escape that summarizes this study				
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(A3)	[Lubaki (1997)]
	• Eighty two HIV-1-speci£c CTL clones from 5 long-term non-progressors were isolated and analyzed for breadth of response • A sustained Gag, Env and Nef response was observed, and clones were restricted by multiple HLA epitopes, indicating a polyclonal response • An A3+ subject had a strong response to this epitope, with 10/11 CTL clones being speci£c for this epitope, isolated at two time points, 1 year apart				
Nef(73–82)	Nef(73–82 BRU)	QVPLRPMTYK	HIV-1 infection	human(A3, A11, B35)	[Culmann (1991)]
	• Nef CTL clones from HIV+ donors				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A3.1)	[Koenig (1995)]
	• Alanine substitutions L76A, R77A, M79A, T80A signi£cantly decreased immunogenicity of peptide • Nef CTL clones (4N225) were infused into an HIV-1 infected volunteer to evaluate effects of infusion on viral load/patient health • Infusion led to outburst of escape variants which resulted in higher viral load/accelerated disease progression				
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(A3.1)	[Betts (2000)]
	• Only 4/11 HLA-A2+ HIV+ individuals had CTL that reacted to SLYNTVATL, calling into question whether it is immunodominant • Ninty £ve optimally de£ned peptides from this database were used to screen for gamma interferon responses to other epitopes • 1/11 of the A2+ individuals was A3, and responded to QVPLRPMTYK as well as two other A3.1 epitopes				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(B*0301)	[Wilson (2000)]
	• Three individuals with highly focused HIV-speci£c CTL responses were studied during acute infection using tetramers – high frequencies of HIV-1-speci£c CD8+ T cells were found prior to seroconversion, and there was a close temporal relationship between the number of circulating HIV-speci£c T cells and viral load was also found • All three patients were B*2705, with HLA alleles: A1, A30/31, B*2705, B35; A1, A*0301, B7, B2705; and A*0201, A*0301, B2705, B39 • ELISPOT was used to test a panel of CTL epitopes that had been de£ned earlier and were appropriate for the HLA haplotypes of the study subjects – 3/3 subjects showed a dominant response to the B*2705 epitope KRWIILGGLNK • The subject with A*0201 had a moderatly strong response to SLYNTVATL • Weak responses were observed to A*301-RLRPGGKKK, A*301-QVPLRPMTYK, and B7-TPGPGVRYPL in the subject who was HLA A1, A*0301, B7, B*2705 • No acute response was detected to the following epitopes: A*201-ILKEPVHGV, A*301-KIRLRPGGK, A*301-AIFQSSMTK, A*301-TVYYGVPVWK, B35-EPIVGAETF, B35-HPDIVIYQY, B35-PPIPVGEIY, B35-NSSKVSQNY, B35-VPLRPMTY, B35-DPNPQEVVL			
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK		human(B27)	[Culmann(1998)]
	• Optimal epitope mapped by peptide titration				
Nef(73–82)	Nef(73–82 LAI)	SVPLRPMTYK	HIV-1 infection	human(B35 or C4)	[Buseyne (1993)]
	• Vertical transmission of HIV ranges from 13% to 39% • Primary assays showed cytotoxic activity against at least one HIV protein was detected in 70% of infected children • Epitopes recognized in £ve children were mapped using synthetic peptides and secondary cultures • Patient EM13, who had a CTL response to three epitopes in Nef, was infected via blood transfusion after birth and went from CDC stage P2A to P2E during the study				
Nef(74–81)	Nef(74–82)	VPLRPMTY		human(A3)	[Carreno (1992)]
	• Included in HLA-A3 binding peptide competition study				
Nef(74–81)	Nef(73–82 LAI)	VPLRPMTY	HIV-1 or HIV-2 infection	human(B*3501)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*3501 epitope				
Nef(74–81)	Nef(75–82)	VPLRPMTY	no CTL shown	human(B*3501)	[Smith (1996)]
	• Crystal structure of VPLRPMTY-class I B allele HLA-B*3501 complex				
Nef(74–81)	Nef(73–82 LAI)	VPLRPMTY	HIV-1 or HIV-2 infection	human(B35)	[McMichael & Walker(1994), Culmann (1991)]
	• Review of HIV CTL epitopes – de£ned by B35 motif found within a larger peptide				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(74–81)	Nef(73–82 LAI)	VPLRPMTY	HIV-1 or -2 infection	human(B35)	[Rowland-Jones (1995)]
	• VPLRPMTY also recognized by CTL from HIV-2 seropositives; epitope is conserved				
Nef(74–81)	Nef()	VPLRPMTY	HIV-1 exposure	human(B35)	[Rowland-Jones (1998a)]
	• A CTL response was found in exposed but uninfected prostitutes from Nairobi using previously-de£ned B clade epitopes that tended to be conserved in A and D clades – such cross-reactivity could protect against both A and D and confer protection in Nairobi where both subtypes are circulating • The A and D subtype consensus are identical to the B clade epitope				
Nef(74–81)	Nef(75–82)	VPLRPMTY	none	human(B35)	[Lalvani (1997)]
	• A peptide-based protocol was optimized for restimulation of CTLp using optimized peptide and IL-7 concentrations – importantly this protocol does not stimulate a primary response, only secondary – peptide-speci£c CTLp counts could be obtained via staining with peptide-Class I tetramers • This peptide was one of the B35 presented test peptides used in control experiments showing that the assay gave no activity using lymphocytes from 21 healthy B35 seronegative donors				
Nef(74–81)	Nef()	VPLRPMTY	HIV-1 exposure	human(B35)	[Rowland-Jones (1998b)]
	• HIV-speci£c CTL were found in exposed seronegative prostitutes from Nairobi – these CTL may confer protection • Seroprevalence in this cohort is 90-95% and their HIV-1 exposure is among the highest in the world • Most isolated HIV strains are clade A in Nairobi, although clades C and D are also found – B clade epitopes are often cross-reactive, however stronger responses are frequently observed using A or D clade versions of epitopes • This epitope is conserved among A, B, and D clade viruses				
Nef(74–81)	Nef()	VPLRPMTY		human(B35)	[Rowland-Jones (1999)]
	• CTL responses in seronegative highly HIV-exposed African female sex workers in Gambia and Nairobi were studied – these women had no delta 32 deletion in CCR5 • In Gambia there is exposure to both HIV-1 and HIV-2, CTL responses to B35 epitopes in exposed, uninfected women are cross-reactive, • HIV-2 version of this epitope is conserved: VPLRPMTY, and CTLs are cross-reactive – one of £ve B35 CTL epitopes that are cross-reactive, see also [Rowland-Jones (1995)]				
Nef(74–82)	Nef(73–82)	VPLRPMTYK	no CTL shown	human(A11)	[Zhang (1993)]
	• Exploration of A11 binding motif				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(75–82)	Nef(75–82 LAI)	PLRPMTYK	HIV-1 infection	human(A*1101)	[McMichael & Walker(1994)]
	• Review of HIV CTL epitopes • C. Brander notes that this is an A*1101 epitope in the 1999 database				
Nef(75–82)	Nef(75–82 LAI)	PLRPMTYK	HIV-1 infection	human(A*1101)	[Brander & Goulder(2001)]
	• C. Brander notes this is an A*1101 epitope				
Nef(77–85)	Nef(77–85 LAI)	RPMTYKAAL	HIV-1 infection	human(B*0702)	[Bauer (1997)]
	• Structural constraints on the Nef protein may prevent escape • Noted in Brander 1999, this database, to be B*0702				
Nef(77–85)	Nef(77–85 LAI)	RPMTYKAAL	HIV-1 infection	human(B*0702)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*0702 epitope				
Nef(82–91)	Nef(82–91 LAI)	KAAVDLSHFL	HIV-1 infection	human(C*0802)	[Nixon (1999)]
	• A patient who made a mono-speci£c CTL response to this Nef speci£c epitope was given effective anti-retroviral therapy within 90 days of infection, reducing the antigenic stimulous • Within 7 days of therapy, his CTLp frequency dropped from 60 to 4 per million PBMC, as his viremia dropped • The patient went from having an activated effector population (detected by CTLp and clone speci£c RNA) to a non-activated quiescent population (detected by the CTL-clone speci£c DNA)				
Nef(82–91)	Nef(82–91 LAI)	KAAVDLSHFL	HIV-1 infection	human(C*0802(Cw8))	[Brander & Goulder(2001)]
	• C. Brander notes this is a C*0802(Cw8) epitope				
Nef(84–91)	Nef(84–91 LAI)	AVDLSHFL	HIV-1 infection	human(Bw62)	[Culmann-Penciolelli (1994)]
Nef(84–91)	Nef(84–91)	AVDLSHFL	HIV-1 infection	human(Bw62)	[Betts (2000)]
	• Only 4/11 HLA-A2+ HIV+ individuals had CTL that reacted to SLYNTVATL, calling into question whether it is immunodominant • Ninty £ve optimally de£ned peptides from this database were used to screen for gamma interferon responses to other epitopes • 1/11 of the A2+ individuals that didn„t respond to SLYNTVATL reacted with seven other epitopes including this epitope				

Table 8: **All De£ned Epitopes within the 20mer, regardless of HLA type**

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(72–79)	Nef()	VPLRPMTY	HIV-1 exposed seronegative	human(B35)	[Kaul (2000)]
	• 11/16 heavily HIV exposed but persistently seronegative sex-workers in Nairobi had HIV-speci£c CD8 gamma-IFN responses in the cervix – systemic CD8+ T cell responses tended to be to the same epitopes but at generally lower levels than cervical CD8+ T cell responses • Low risk individuals did not have such CD8+ cells • CD8+ epitopes T cell DTVLEDINL (3 individuals), SLYNVATL (4 individuals), LSPRTLNAW (3 individuals) and YPLTFGWCF (4 individuals) were most commonly recognized by the HIV-resistant women				
Nef(72–79)	Nef()	VPLRPMTY	HIV-1 infection	human(B35)	[Wilson (2000)]
	• Three individuals with highly focused HIV-speci£c CTL responses were studied during acute infection using tetramers – high frequencies of HIV-1-speci£c CD8+ T cells were found prior to seroconversion, and there was a close temporal relationship between the number of circulating HIV-speci£c T cells and viral load was also found • All three patients were B*2705, with HLA alleles: A1, A30/31, B*2705, B35; A1, A*0301, B7, B2705; and A*0201, A*0301, B2705, B39 • ELISPOT was used to test a panel of CTL epitopes that had been de£ned earlier and were appropriate for the HLA haplotypes of the study subjects – 3/3 subjects showed a dominant response to the B*2705 epitope KRWIILGGLNK • The subject with A*0201 had a moderatly strong response to SLYNTVATL • Weak responses were observed to A*301-RLRPGGKKK, A*301-QVPLRPMTYK, and B7-TPGPGVRYPL in the subject who was HLA A1, A*0301, B7, B*2705 • No acute response was detected to the following epitopes: A*201-ILKEPVHGV, A*301-KIRLRPGGK, A*301-AIFQSSMTK, A*301-TVYYGVPVWK, B35-EPIVGAETF, B35-HPDIVIYQY, B35-PPIPVGEIY, B35-NSSKVSQNY, B35-VPLRPMTY, B35-DPNPQEVVL			
Nef(72–91)	Nef(71–90 SF2)	PQVPLRMTYKAAVDLSHFL	HIV-1 infection	human()	[Lieberman (1997a)]
	• Of 25 patients, most had CTL speci£c for more than 1 HIV-1 protein • Eleven subjects had CTL that could recognize vaccinia-expressed LAI Nef • Three of these 11 had CTL response to this peptide • The responding subjects were HLA-A3, A32, B51, B62; HLA-A11, A24, B8, B53				
Nef(72–91)	Nef(71–90 SF2)	PQVPLRPMTYKAAVDLSHFL	HIV-1 infection	human()	[Lieberman (1997b)]
	• CTL expanded *ex vivo* were later infused into HIV-1 infected patients				
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV infection	human()	[Garcia (1997)]
	• The anti-Nef CTL line P1 speci£c for this epitope is able to kill target cells via two mechanisms • First: Ca^{2+}-dependent, perforin-dependent Nef-speci£c lysis • Second: Ca^{2+}-independent, CD95-dependent apoptosis that could also kill non-speci£c targets • Findings indicate that the two mechanisms are not mutually exclusive in human CTL, as they are in mice • CTL mediated CD95-dependent apoptosis may play a role in pathogenesis				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(73–82)	Nef(73–82 NL43)	QVPLRPMTYK	HIV-1 infection	human(A*0301)	[Koenig (1990)]
	• 81 Tyr is critical for binding to A3.1 • C. Brander notes that this is an A*0301 epitope in the 1999 database				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK		human(A*0301)	[Brander & Goulder(2001)]
	• C. Brander notes this is an A*0301 epitope				
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(A11)	[Le Borgne (2000)]
	• Soluble factors in supernatant from both an HIV-speci£c cloned CTL line and an EBV (Epstein-Barr-virus) CTL line inhibit viral replication, but do not block viral entry in CD4+ T lymphocytes, by a noncytotoxic mechanism				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A11)	[Robertson (1993)]
	• Development of a retroviral vector (pNeoNef) to generate autologous CTL targets • [Hunziker (1998)] suggests that HLA-A2 does not in fact present this epitope • The initial assignment of HLA-A2 presentation for this epitope was based on a serological HLA typing. Subsequently, the authors revisited the issue with genetic HLA typing and found that HLA-A11 was the correct presenting molecule (Dr. Florence Buseyne, Pers. Comm., 2000)				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A11)	[Couillin (1994), Goulder (1997a)]
	• Mutational variation in HIV epitopes in individuals with appropriate HLA types can result in evasion of CTL response • [Goulder (1997a)] is a review of immune escape that summarizes this study				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A11)	[Couillin (1995)]
	• Mutations found in this epitope in HLA-A11 positive and negative donors were characterized				
Nef(73–82)	()	QVPLRPMTYK		(A11)	[Brander & Goulder(2001), Buseyne(1999)]
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-infection	human(A3)	[Chassin (1999)]
	• Mutations in Nef that ¤ank this epitope, Thr71Lys and Ala83Gly, may account for an observed loss of CTL reactivity, with escape due to the introduction of proteasome processing defects				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(A3)	[Durali (1998)]
	• Cross-clade CTL response was studied by determining the CTL activity in seven patients from Bangui, (6 A subtype, and 1 AG recombinant infections) and one A subtype infection from a person living in France originally from Togo, to different antigens expressed in vaccinia • Pol reactivity: 8/8 had CTL to A subtype, and 7/8 to B subtype, and HIV-2 Pol was not tested • Gag reactivity: 7/8 reacted with A or B subtype gag, 3/8 with HIV-2 Gag • Nef reactivity: 7/8 reacted with A subtype, and 5/8 with B subtype, none with HIV-2 Nef • Env reactivity: 3/8 reacted with A subtype, 1/8 with B subtype, none with HIV-2 Env • One of the patients was shown to react to this epitope: QVPLRPMTYK			
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A3)	[Goulder (1997b), Goulder (1997a)]
	• Identical twin hemophiliac brothers were both infected with the same batch of factor VIII • Both had a response to this epitope • [Goulder (1997a)] is a review of immune escape that summarizes this study				
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(A3)	[Lubaki (1997)]
	• Eighty two HIV-1-speci£c CTL clones from 5 long-term non-progressors were isolated and analyzed for breadth of response • A sustained Gag, Env and Nef response was observed, and clones were restricted by multiple HLA epitopes, indicating a polyclonal response • An A3+ subject had a strong response to this epitope, with 10/11 CTL clones being speci£c for this epitope, isolated at two time points, 1 year apart				
Nef(73–82)	Nef(73–82 BRU)	QVPLRPMTYK	HIV-1 infection	human(A3, A11, B35)	[Culmann (1991)]
	• Nef CTL clones from HIV+ donors				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A3.1)	[Koenig (1995)]
	• Alanine substitutions L76A, R77A, M79A, T80A signi£cantly decreased immunogenicity of peptide • Nef CTL clones (4N225) were infused into an HIV-1 infected volunteer to evaluate effects of infusion on viral load/patient health • Infusion led to outburst of escape variants which resulted in higher viral load/accelerated disease progression				
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(A3.1)	[Betts (2000)]
	• Only 4/11 HLA-A2+ HIV+ individuals had CTL that reacted to SLYNTVATL, calling into question whether it is immunodominant • Ninty £ve optimally de£ned peptides from this database were used to screen for gamma interferon responses to other epitopes • 1/11 of the A2+ individuals was A3, and responded to QVPLRPMTYK as well as two other A3.1 epitopes				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(B*0301)	[Wilson (2000)]
	• Three individuals with highly focused HIV-speci£c CTL responses were studied during acute infection using tetramers – high frequencies of HIV-1-speci£c CD8+ T cells were found prior to seroconversion, and there was a close temporal relationship between the number of circulating HIV-speci£c T cells and viral load was also found • All three patients were B*2705, with HLA alleles: A1, A30/31, B*2705, B35; A1, A*0301, B7, B2705; and A*0201, A*0301, B2705, B39 • ELISPOT was used to test a panel of CTL epitopes that had been de£ned earlier and were appropriate for the HLA haplotypes of the study subjects – 3/3 subjects showed a dominant response to the B*2705 epitope KRWIILGGLNK • The subject with A*0201 had a moderatly strong response to SLYNTVATL • Weak responses were observed to A*301-RLRPGGKKK, A*301-QVPLRPMTYK, and B7-TPGPGVRYPL in the subject who was HLA A1, A*0301, B7, B*2705 • No acute response was detected to the following epitopes: A*201-ILKEPVHGV, A*301-KIRLRPGGK, A*301-AIFQSSMTK, A*301-TVYYGVPVWK, B35-EPIVGAETF, B35-HPDIVIYQY, B35-PPIPVGEIY, B35-NSSKVSQNY, B35-VPLRPMTY, B35-DPNPQEVVL			
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK		human(B27)	[Culmann(1998)]
	• Optimal epitope mapped by peptide titration				
Nef(73–82)	Nef(73–82 LAI)	SVPLRPMTYK	HIV-1 infection	human(B35 or C4)	[Buseyne (1993)]
	• Vertical transmission of HIV ranges from 13% to 39% • Primary assays showed cytotoxic activity against at least one HIV protein was detected in 70% of infected children • Epitopes recognized in £ve children were mapped using synthetic peptides and secondary cultures • Patient EM13, who had a CTL response to three epitopes in Nef, was infected via blood transfusion after birth and went from CDC stage P2A to P2E during the study				
Nef(74–81)	Nef(74–82)	VPLRPMTY		human(A3)	[Carreno (1992)]
	• Included in HLA-A3 binding peptide competition study				
Nef(74–81)	Nef(73–82 LAI)	VPLRPMTY	HIV-1 or HIV-2 infection	human(B*3501)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*3501 epitope				
Nef(74–81)	Nef(75–82)	VPLRPMTY	no CTL shown	human(B*3501)	[Smith (1996)]
	• Crystal structure of VPLRPMTY-class I B allele HLA-B*3501 complex				
Nef(74–81)	Nef(73–82 LAI)	VPLRPMTY	HIV-1 or HIV-2 infection	human(B35)	[McMichael & Walker(1994), Culmann (1991)]
	• Review of HIV CTL epitopes – de£ned by B35 motif found within a larger peptide				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(74–81)	Nef(73–82 LAI)	VPLRPMTY	HIV-1 or -2 infection	human(B35)	[Rowland-Jones (1995)]
	• VPLRPMTY also recognized by CTL from HIV-2 seropositives; epitope is conserved				
Nef(74–81)	Nef()	VPLRPMTY	HIV-1 exposure	human(B35)	[Rowland-Jones (1998a)]
	• A CTL response was found in exposed but uninfected prostitutes from Nairobi using previously-de£ned B clade epitopes that tended to be conserved in A and D clades – such cross-reactivity could protect against both A and D and confer protection in Nairobi where both subtypes are circulating • The A and D subtype consensus are identical to the B clade epitope				
Nef(74–81)	Nef(75–82)	VPLRPMTY	none	human(B35)	[Lalvani (1997)]
	• A peptide-based protocol was optimized for restimulation of CTLp using optimized peptide and IL-7 concentrations – importantly this protocol does not stimulate a primary response, only secondary – peptide-speci£c CTLp counts could be obtained via staining with peptide-Class I tetramers • This peptide was one of the B35 presented test peptides used in control experiments showing that the assay gave no activity using lymphocytes from 21 healthy B35 seronegative donors				
Nef(74–81)	Nef()	VPLRPMTY	HIV-1 exposure	human(B35)	[Rowland-Jones (1998b)]
	• HIV-speci£c CTL were found in exposed seronegative prostitutes from Nairobi – these CTL may confer protection • Seroprevalence in this cohort is 90-95% and their HIV-1 exposure is among the highest in the world • Most isolated HIV strains are clade A in Nairobi, although clades C and D are also found – B clade epitopes are often cross-reactive, however stronger responses are frequently observed using A or D clade versions of epitopes • This epitope is conserved among A, B, and D clade viruses				
Nef(74–81)	Nef()	VPLRPMTY		human(B35)	[Rowland-Jones (1999)]
	• CTL responses in seronegative highly HIV-exposed African female sex workers in Gambia and Nairobi were studied – these women had no delta 32 deletion in CCR5 • In Gambia there is exposure to both HIV-1 and HIV-2, CTL responses to B35 epitopes in exposed, uninfected women are cross-reactive, • HIV-2 version of this epitope is conserved: VPLRPMTY, and CTLs are cross-reactive – one of £ve B35 CTL epitopes that are cross-reactive, see also [Rowland-Jones (1995)]				
Nef(74–82)	Nef(73–82)	VPLRPMTYK	no CTL shown	human(A11)	[Zhang (1993)]
	• Exploration of A11 binding motif				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(75–82)	Nef(75–82 LAI)	PLRPMTYK	HIV-1 infection	human(A*1101)	[McMichael & Walker(1994)]
	• Review of HIV CTL epitopes • C. Brander notes that this is an A*1101 epitope in the 1999 database				
Nef(75–82)	Nef(75–82 LAI)	PLRPMTYK	HIV-1 infection	human(A*1101)	[Brander & Goulder(2001)]
	• C. Brander notes this is an A*1101 epitope				
Nef(77–85)	Nef(77–85 LAI)	RPMTYKAAL	HIV-1 infection	human(B*0702)	[Bauer (1997)]
	• Structural constraints on the Nef protein may prevent escape • Noted in Brander 1999, this database, to be B*0702				
Nef(77–85)	Nef(77–85 LAI)	RPMTYKAAL	HIV-1 infection	human(B*0702)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*0702 epitope				
Nef(82–91)	Nef(82–91 LAI)	KAAVDLSHFL	HIV-1 infection	human(C*0802)	[Nixon (1999)]
	• A patient who made a mono-speci£c CTL response to this Nef speci£c epitope was given effective anti-retroviral therapy within 90 days of infection, reducing the antigenic stimulous • Within 7 days of therapy, his CTLp frequency dropped from 60 to 4 per million PBMC, as his viremia dropped • The patient went from having an activated effector population (detected by CTLp and clone speci£c RNA) to a non-activated quiescent population (detected by the CTL-clone speci£c DNA)				
Nef(82–91)	Nef(82–91 LAI)	KAAVDLSHFL	HIV-1 infection	human(C*0802(Cw8))	[Brander & Goulder(2001)]
	• C. Brander notes this is a C*0802(Cw8) epitope				
Nef(84–91)	Nef(84–91 LAI)	AVDLSHFL	HIV-1 infection	human(Bw62)	[Culmann-Penciolelli (1994)]
Nef(84–91)	Nef(84–91)	AVDLSHFL	HIV-1 infection	human(Bw62)	[Betts (2000)]
	• Only 4/11 HLA-A2+ HIV+ individuals had CTL that reacted to SLYNTVATL, calling into question whether it is immunodominant • Ninty £ve optimally de£ned peptides from this database were used to screen for gamma interferon responses to other epitopes • 1/11 of the A2+ individuals that didn„t respond to SLYNTVATL reacted with seven other epitopes including this epitope				

Table 9: **All De£ned Epitopes within the 20mer, regardless of HLA type**

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(72–79)	Nef()	VPLRPMTY	HIV-1 exposed seronegative	human(B35)	[Kaul (2000)]
	• 11/16 heavily HIV exposed but persistently seronegative sex-workers in Nairobi had HIV-speci£c CD8 gamma-IFN responses in the cervix – systemic CD8+ T cell responses tended to be to the same epitopes but at generally lower levels than cervical CD8+ T cell responses • Low risk individuals did not have such CD8+ cells • CD8+ epitopes T cell DTVLEDINL (3 individuals), SLYNVATL (4 individuals), LSPRTLNAW (3 individuals) and YPLTFGWCF (4 individuals) were most commonly recognized by the HIV-resistant women				
Nef(72–79)	Nef()	VPLRPMTY	HIV-1 infection	human(B35)	[Wilson (2000)]
	• Three individuals with highly focused HIV-speci£c CTL responses were studied during acute infection using tetramers – high frequencies of HIV-1-speci£c CD8+ T cells were found prior to seroconversion, and there was a close temporal relationship between the number of circulating HIV-speci£c T cells and viral load was also found • All three patients were B*2705, with HLA alleles: A1, A30/31, B*2705, B35; A1, A*0301, B7, B2705; and A*0201, A*0301, B2705, B39 • ELISPOT was used to test a panel of CTL epitopes that had been de£ned earlier and were appropriate for the HLA haplotypes of the study subjects – 3/3 subjects showed a dominant response to the B*2705 epitope KRWIILGGLNK • The subject with A*0201 had a moderatly strong response to SLYNTVATL • Weak responses were observed to A*301-RLRPGGKKK, A*301-QVPLRPMTYK, and B7-TPGPGVRYPL in the subject who was HLA A1, A*0301, B7, B*2705 • No acute response was detected to the following epitopes: A*201-ILKEPVHGV, A*301-KIRLRPGGK, A*301-AIFQSSMTK, A*301-TVYYGVPVWK, B35-EPIVGAETF, B35-HPDIVIYQY, B35-PPIPVGEIY, B35-NSSKVSQNY, B35-VPLRPMTY, B35-DPNPQEVVL			
Nef(72–91)	Nef(71–90 SF2)	PQVPLRMTYKAAVDLSHFL	HIV-1 infection	human()	[Lieberman (1997a)]
	• Of 25 patients, most had CTL speci£c for more than 1 HIV-1 protein • Eleven subjects had CTL that could recognize vaccinia-expressed LAI Nef • Three of these 11 had CTL response to this peptide • The responding subjects were HLA-A3, A32, B51, B62; HLA-A11, A24, B8, B53				
Nef(72–91)	Nef(71–90 SF2)	PQVPLRPMTYKAAVDLSHFL	HIV-1 infection	human()	[Lieberman (1997b)]
	• CTL expanded *ex vivo* were later infused into HIV-1 infected patients				
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV infection	human()	[Garcia (1997)]
	• The anti-Nef CTL line P1 speci£c for this epitope is able to kill target cells via two mechanisms • First: Ca^{2+}-dependent, perforin-dependent Nef-speci£c lysis • Second: Ca^{2+}-independent, CD95-dependent apoptosis that could also kill non-speci£c targets • Findings indicate that the two mechanisms are not mutually exclusive in human CTL, as they are in mice • CTL mediated CD95-dependent apoptosis may play a role in pathogenesis				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(73–82)	Nef(73–82 NL43)	QVPLRPMTYK	HIV-1 infection	human(A*0301)	[Koenig (1990)]
	• 81 Tyr is critical for binding to A3.1 • C. Brander notes that this is an A*0301 epitope in the 1999 database				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK		human(A*0301)	[Brander & Goulder(2001)]
	• C. Brander notes this is an A*0301 epitope				
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(A11)	[Le Borgne (2000)]
	• Soluble factors in supernatant from both an HIV-speci£c cloned CTL line and an EBV (Epstein-Barr-virus) CTL line inhibit viral replication, but do not block viral entry in CD4+ T lymphocytes, by a noncytotoxic mechanism				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A11)	[Robertson (1993)]
	• Development of a retroviral vector (pNeoNef) to generate autologous CTL targets • [Hunziker (1998)] suggests that HLA-A2 does not in fact present this epitope • The initial assignment of HLA-A2 presentation for this epitope was based on a serological HLA typing. Subsequently, the authors revisited the issue with genetic HLA typing and found that HLA-A11 was the correct presenting molecule (Dr. Florence Buseyne, Pers. Comm., 2000)				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A11)	[Couillin (1994), Goulder (1997a)]
	• Mutational variation in HIV epitopes in individuals with appropriate HLA types can result in evasion of CTL response • [Goulder (1997a)] is a review of immune escape that summarizes this study				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A11)	[Couillin (1995)]
	• Mutations found in this epitope in HLA-A11 positive and negative donors were characterized				
Nef(73–82)	()	QVPLRPMTYK		(A11)	[Brander & Goulder(2001), Buseyne(1999)]
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-infection	human(A3)	[Chassin (1999)]
	• Mutations in Nef that ¤ank this epitope, Thr71Lys and Ala83Gly, may account for an observed loss of CTL reactivity, with escape due to the introduction of proteasome processing defects				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(A3)	[Durali (1998)]
	• Cross-clade CTL response was studied by determining the CTL activity in seven patients from Bangui, (6 A subtype, and 1 AG recombinant infections) and one A subtype infection from a person living in France originally from Togo, to different antigens expressed in vaccinia • Pol reactivity: 8/8 had CTL to A subtype, and 7/8 to B subtype, and HIV-2 Pol was not tested • Gag reactivity: 7/8 reacted with A or B subtype gag, 3/8 with HIV-2 Gag • Nef reactivity: 7/8 reacted with A subtype, and 5/8 with B subtype, none with HIV-2 Nef • Env reactivity: 3/8 reacted with A subtype, 1/8 with B subtype, none with HIV-2 Env • One of the patients was shown to react to this epitope: QVPLRPMTYK			
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A3)	[Goulder (1997b), Goulder (1997a)]
	• Identical twin hemophiliac brothers were both infected with the same batch of factor VIII • Both had a response to this epitope • [Goulder (1997a)] is a review of immune escape that summarizes this study				
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(A3)	[Lubaki (1997)]
	• Eighty two HIV-1-speci£c CTL clones from 5 long-term non-progressors were isolated and analyzed for breadth of response • A sustained Gag, Env and Nef response was observed, and clones were restricted by multiple HLA epitopes, indicating a polyclonal response • An A3+ subject had a strong response to this epitope, with 10/11 CTL clones being speci£c for this epitope, isolated at two time points, 1 year apart				
Nef(73–82)	Nef(73–82 BRU)	QVPLRPMTYK	HIV-1 infection	human(A3, A11, B35)	[Culmann (1991)]
	• Nef CTL clones from HIV+ donors				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A3.1)	[Koenig (1995)]
	• Alanine substitutions L76A, R77A, M79A, T80A signi£cantly decreased immunogenicity of peptide • Nef CTL clones (4N225) were infused into an HIV-1 infected volunteer to evaluate effects of infusion on viral load/patient health • Infusion led to outburst of escape variants which resulted in higher viral load/accelerated disease progression				
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(A3.1)	[Betts (2000)]
	• Only 4/11 HLA-A2+ HIV+ individuals had CTL that reacted to SLYNTVATL, calling into question whether it is immunodominant • Ninty £ve optimally de£ned peptides from this database were used to screen for gamma interferon responses to other epitopes • 1/11 of the A2+ individuals was A3, and responded to QVPLRPMTYK as well as two other A3.1 epitopes				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(B*0301)	[Wilson (2000)]
	• Three individuals with highly focused HIV-speci£c CTL responses were studied during acute infection using tetramers – high frequencies of HIV-1-speci£c CD8+ T cells were found prior to seroconversion, and there was a close temporal relationship between the number of circulating HIV-speci£c T cells and viral load was also found • All three patients were B*2705, with HLA alleles: A1, A30/31, B*2705, B35; A1, A*0301, B7, B2705; and A*0201, A*0301, B2705, B39 • ELISPOT was used to test a panel of CTL epitopes that had been de£ned earlier and were appropriate for the HLA haplotypes of the study subjects – 3/3 subjects showed a dominant response to the B*2705 epitope KRWIILGGLNK • The subject with A*0201 had a moderatly strong response to SLYNTVATL • Weak responses were observed to A*301-RLRPGGKKK, A*301-QVPLRPMTYK, and B7-TPGPGVRYPL in the subject who was HLA A1, A*0301, B7, B*2705 • No acute response was detected to the following epitopes: A*201-ILKEPVHGV, A*301-KIRLRPGGK, A*301-AIFQSSMTK, A*301-TVYYGVPVWK, B35-EPIVGAETF, B35-HPDIVIYQY, B35-PPIPVGEIY, B35-NSSKVSQNY, B35-VPLRPMTY, B35-DPNPQEVVL			
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK		human(B27)	[Culmann(1998)]
	• Optimal epitope mapped by peptide titration				
Nef(73–82)	Nef(73–82 LAI)	SVPLRPMTYK	HIV-1 infection	human(B35 or C4)	[Buseyne (1993)]
	• Vertical transmission of HIV ranges from 13% to 39% • Primary assays showed cytotoxic activity against at least one HIV protein was detected in 70% of infected children • Epitopes recognized in £ve children were mapped using synthetic peptides and secondary cultures • Patient EM13, who had a CTL response to three epitopes in Nef, was infected via blood transfusion after birth and went from CDC stage P2A to P2E during the study				
Nef(74–81)	Nef(74–82)	VPLRPMTY		human(A3)	[Carreno (1992)]
	• Included in HLA-A3 binding peptide competition study				
Nef(74–81)	Nef(73–82 LAI)	VPLRPMTY	HIV-1 or HIV-2 infection	human(B*3501)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*3501 epitope				
Nef(74–81)	Nef(75–82)	VPLRPMTY	no CTL shown	human(B*3501)	[Smith (1996)]
	• Crystal structure of VPLRPMTY-class I B allele HLA-B*3501 complex				
Nef(74–81)	Nef(73–82 LAI)	VPLRPMTY	HIV-1 or HIV-2 infection	human(B35)	[McMichael & Walker(1994), Culmann (1991)]
	• Review of HIV CTL epitopes – de£ned by B35 motif found within a larger peptide				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(74–81)	Nef(73–82 LAI)	VPLRPMTY	HIV-1 or -2 infection	human(B35)	[Rowland-Jones (1995)]
	• VPLRPMTY also recognized by CTL from HIV-2 seropositives; epitope is conserved				
Nef(74–81)	Nef()	VPLRPMTY	HIV-1 exposure	human(B35)	[Rowland-Jones (1998a)]
	• A CTL response was found in exposed but uninfected prostitutes from Nairobi using previously-de£ned B clade epitopes that tended to be conserved in A and D clades – such cross-reactivity could protect against both A and D and confer protection in Nairobi where both subtypes are circulating • The A and D subtype consensus are identical to the B clade epitope				
Nef(74–81)	Nef(75–82)	VPLRPMTY	none	human(B35)	[Lalvani (1997)]
	• A peptide-based protocol was optimized for restimulation of CTLp using optimized peptide and IL-7 concentrations – importantly this protocol does not stimulate a primary response, only secondary – peptide-speci£c CTLp counts could be obtained via staining with peptide-Class I tetramers • This peptide was one of the B35 presented test peptides used in control experiments showing that the assay gave no activity using lymphocytes from 21 healthy B35 seronegative donors				
Nef(74–81)	Nef()	VPLRPMTY	HIV-1 exposure	human(B35)	[Rowland-Jones (1998b)]
	• HIV-speci£c CTL were found in exposed seronegative prostitutes from Nairobi – these CTL may confer protection • Seroprevalence in this cohort is 90-95% and their HIV-1 exposure is among the highest in the world • Most isolated HIV strains are clade A in Nairobi, although clades C and D are also found – B clade epitopes are often cross-reactive, however stronger responses are frequently observed using A or D clade versions of epitopes • This epitope is conserved among A, B, and D clade viruses				
Nef(74–81)	Nef()	VPLRPMTY		human(B35)	[Rowland-Jones (1999)]
	• CTL responses in seronegative highly HIV-exposed African female sex workers in Gambia and Nairobi were studied – these women had no delta 32 deletion in CCR5 • In Gambia there is exposure to both HIV-1 and HIV-2, CTL responses to B35 epitopes in exposed, uninfected women are cross-reactive, • HIV-2 version of this epitope is conserved: VPLRPMTY, and CTLs are cross-reactive – one of £ve B35 CTL epitopes that are cross-reactive, see also [Rowland-Jones (1995)]				
Nef(74–82)	Nef(73–82)	VPLRPMTYK	no CTL shown	human(A11)	[Zhang (1993)]
	• Exploration of A11 binding motif				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(75–82)	Nef(75–82 LAI)	PLRPMTYK	HIV-1 infection	human(A*1101)	[McMichael & Walker(1994)]
	• Review of HIV CTL epitopes • C. Brander notes that this is an A*1101 epitope in the 1999 database				
Nef(75–82)	Nef(75–82 LAI)	PLRPMTYK	HIV-1 infection	human(A*1101)	[Brander & Goulder(2001)]
	• C. Brander notes this is an A*1101 epitope				
Nef(77–85)	Nef(77–85 LAI)	RPMTYKAAL	HIV-1 infection	human(B*0702)	[Bauer (1997)]
	• Structural constraints on the Nef protein may prevent escape • Noted in Brander 1999, this database, to be B*0702				
Nef(77–85)	Nef(77–85 LAI)	RPMTYKAAL	HIV-1 infection	human(B*0702)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*0702 epitope				
Nef(82–91)	Nef(82–91 LAI)	KAAVDLSHFL	HIV-1 infection	human(C*0802)	[Nixon (1999)]
	• A patient who made a mono-speci£c CTL response to this Nef speci£c epitope was given effective anti-retroviral therapy within 90 days of infection, reducing the antigenic stimulous • Within 7 days of therapy, his CTLp frequency dropped from 60 to 4 per million PBMC, as his viremia dropped • The patient went from having an activated effector population (detected by CTLp and clone speci£c RNA) to a non-activated quiescent population (detected by the CTL-clone speci£c DNA)				
Nef(82–91)	Nef(82–91 LAI)	KAAVDLSHFL	HIV-1 infection	human(C*0802(Cw8))	[Brander & Goulder(2001)]
	• C. Brander notes this is a C*0802(Cw8) epitope				
Nef(84–91)	Nef(84–91 LAI)	AVDLSHFL	HIV-1 infection	human(Bw62)	[Culmann-Penciolelli (1994)]
Nef(84–91)	Nef(84–91)	AVDLSHFL	HIV-1 infection	human(Bw62)	[Betts (2000)]
	• Only 4/11 HLA-A2+ HIV+ individuals had CTL that reacted to SLYNTVATL, calling into question whether it is immunodominant • Ninty £ve optimally de£ned peptides from this database were used to screen for gamma interferon responses to other epitopes • 1/11 of the A2+ individuals that didn„t respond to SLYNTVATL reacted with seven other epitopes including this epitope				

Table 10: **All De£ned Epitopes within the 20mer, regardless of HLA type**

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(72–79)	Nef()	VPLRPMTY	HIV-1 exposed seronegative	human(B35)	[Kaul (2000)]
	• 11/16 heavily HIV exposed but persistently seronegative sex-workers in Nairobi had HIV-speci£c CD8 gamma-IFN responses in the cervix – systemic CD8+ T cell responses tended to be to the same epitopes but at generally lower levels than cervical CD8+ T cell responses • Low risk individuals did not have such CD8+ cells • CD8+ epitopes T cell DTVLEDINL (3 individuals), SLYNVATL (4 individuals), LSPRTLNAW (3 individuals) and YPLTFGWCF (4 individuals) were most commonly recognized by the HIV-resistant women				
Nef(72–79)	Nef()	VPLRPMTY	HIV-1 infection	human(B35)	[Wilson (2000)]
	• Three individuals with highly focused HIV-speci£c CTL responses were studied during acute infection using tetramers – high frequencies of HIV-1-speci£c CD8+ T cells were found prior to seroconversion, and there was a close temporal relationship between the number of circulating HIV-speci£c T cells and viral load was also found • All three patients were B*2705, with HLA alleles: A1, A30/31, B*2705, B35; A1, A*0301, B7, B2705; and A*0201, A*0301, B2705, B39 • ELISPOT was used to test a panel of CTL epitopes that had been de£ned earlier and were appropriate for the HLA haplotypes of the study subjects – 3/3 subjects showed a dominant response to the B*2705 epitope KRWIILGGLNK • The subject with A*0201 had a moderatly strong response to SLYNTVATL • Weak responses were observed to A*301-RLRPGGKKK, A*301-QVPLRPMTYK, and B7-TPGPGVRYPL in the subject who was HLA A1, A*0301, B7, B*2705 • No acute response was detected to the following epitopes: A*201-ILKEPVHGV, A*301-KIRLRPGGK, A*301-AIFQSSMTK, A*301-TVYYGVPVWK, B35-EPIVGAETF, B35-HPDIVIYQY, B35-PPIPVGEIY, B35-NSSKVSQNY, B35-VPLRPMTY, B35-DPNPQEVVL			
Nef(72–91)	Nef(71–90 SF2)	PQVPLRMTYKAAVDLSHFL	HIV-1 infection	human()	[Lieberman (1997a)]
	• Of 25 patients, most had CTL speci£c for more than 1 HIV-1 protein • Eleven subjects had CTL that could recognize vaccinia-expressed LAI Nef • Three of these 11 had CTL response to this peptide • The responding subjects were HLA-A3, A32, B51, B62; HLA-A11, A24, B8, B53				
Nef(72–91)	Nef(71–90 SF2)	PQVPLRPMTYKAAVDLSHFL	HIV-1 infection	human()	[Lieberman (1997b)]
	• CTL expanded *ex vivo* were later infused into HIV-1 infected patients				
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV infection	human()	[Garcia (1997)]
	• The anti-Nef CTL line P1 speci£c for this epitope is able to kill target cells via two mechanisms • First: Ca^{2+}-dependent, perforin-dependent Nef-speci£c lysis • Second: Ca^{2+}-independent, CD95-dependent apoptosis that could also kill non-speci£c targets • Findings indicate that the two mechanisms are not mutually exclusive in human CTL, as they are in mice • CTL mediated CD95-dependent apoptosis may play a role in pathogenesis				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(73–82)	Nef(73–82 NL43)	QVPLRPMTYK	HIV-1 infection	human(A*0301)	[Koenig (1990)]
	• 81 Tyr is critical for binding to A3.1 • C. Brander notes that this is an A*0301 epitope in the 1999 database				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK		human(A*0301)	[Brander & Goulder(2001)]
	• C. Brander notes this is an A*0301 epitope				
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(A11)	[Le Borgne (2000)]
	• Soluble factors in supernatant from both an HIV-speci£c cloned CTL line and an EBV (Epstein-Barr-virus) CTL line inhibit viral replication, but do not block viral entry in CD4+ T lymphocytes, by a noncytotoxic mechanism				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A11)	[Robertson (1993)]
	• Development of a retroviral vector (pNeoNef) to generate autologous CTL targets • [Hunziker (1998)] suggests that HLA-A2 does not in fact present this epitope • The initial assignment of HLA-A2 presentation for this epitope was based on a serological HLA typing. Subsequently, the authors revisited the issue with genetic HLA typing and found that HLA-A11 was the correct presenting molecule (Dr. Florence Buseyne, Pers. Comm., 2000)				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A11)	[Couillin (1994), Goulder (1997a)]
	• Mutational variation in HIV epitopes in individuals with appropriate HLA types can result in evasion of CTL response • [Goulder (1997a)] is a review of immune escape that summarizes this study				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A11)	[Couillin (1995)]
	• Mutations found in this epitope in HLA-A11 positive and negative donors were characterized				
Nef(73–82)	()	QVPLRPMTYK		(A11)	[Brander & Goulder(2001), Buseyne(1999)]
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-infection	human(A3)	[Chassin (1999)]
	• Mutations in Nef that ¤ank this epitope, Thr71Lys and Ala83Gly, may account for an observed loss of CTL reactivity, with escape due to the introduction of proteasome processing defects				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(A3)	[Durali (1998)]
	• Cross-clade CTL response was studied by determining the CTL activity in seven patients from Bangui, (6 A subtype, and 1 AG recombinant infections) and one A subtype infection from a person living in France originally from Togo, to different antigens expressed in vaccinia • Pol reactivity: 8/8 had CTL to A subtype, and 7/8 to B subtype, and HIV-2 Pol was not tested • Gag reactivity: 7/8 reacted with A or B subtype gag, 3/8 with HIV-2 Gag • Nef reactivity: 7/8 reacted with A subtype, and 5/8 with B subtype, none with HIV-2 Nef • Env reactivity: 3/8 reacted with A subtype, 1/8 with B subtype, none with HIV-2 Env • One of the patients was shown to react to this epitope: QVPLRPMTYK			
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A3)	[Goulder (1997b), Goulder (1997a)]
	• Identical twin hemophiliac brothers were both infected with the same batch of factor VIII • Both had a response to this epitope • [Goulder (1997a)] is a review of immune escape that summarizes this study				
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(A3)	[Lubaki (1997)]
	• Eighty two HIV-1-speci£c CTL clones from 5 long-term non-progressors were isolated and analyzed for breadth of response • A sustained Gag, Env and Nef response was observed, and clones were restricted by multiple HLA epitopes, indicating a polyclonal response • An A3+ subject had a strong response to this epitope, with 10/11 CTL clones being speci£c for this epitope, isolated at two time points, 1 year apart				
Nef(73–82)	Nef(73–82 BRU)	QVPLRPMTYK	HIV-1 infection	human(A3, A11, B35)	[Culmann (1991)]
	• Nef CTL clones from HIV+ donors				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A3.1)	[Koenig (1995)]
	• Alanine substitutions L76A, R77A, M79A, T80A signi£cantly decreased immunogenicity of peptide • Nef CTL clones (4N225) were infused into an HIV-1 infected volunteer to evaluate effects of infusion on viral load/patient health • Infusion led to outburst of escape variants which resulted in higher viral load/accelerated disease progression				
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(A3.1)	[Betts (2000)]
	• Only 4/11 HLA-A2+ HIV+ individuals had CTL that reacted to SLYNTVATL, calling into question whether it is immunodominant • Ninty £ve optimally de£ned peptides from this database were used to screen for gamma interferon responses to other epitopes • 1/11 of the A2+ individuals was A3, and responded to QVPLRPMTYK as well as two other A3.1 epitopes				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(B*0301)	[Wilson (2000)]
	• Three individuals with highly focused HIV-speci£c CTL responses were studied during acute infection using tetramers – high frequencies of HIV-1-speci£c CD8+ T cells were found prior to seroconversion, and there was a close temporal relationship between the number of circulating HIV-speci£c T cells and viral load was also found • All three patients were B*2705, with HLA alleles: A1, A30/31, B*2705, B35; A1, A*0301, B7, B2705; and A*0201, A*0301, B2705, B39 • ELISPOT was used to test a panel of CTL epitopes that had been de£ned earlier and were appropriate for the HLA haplotypes of the study subjects – 3/3 subjects showed a dominant response to the B*2705 epitope KRWIILGGLNK • The subject with A*0201 had a moderatly strong response to SLYNTVATL • Weak responses were observed to A*301-RLRPGGKKK, A*301-QVPLRPMTYK, and B7-TPGPGVRYPL in the subject who was HLA A1, A*0301, B7, B*2705 • No acute response was detected to the following epitopes: A*201-ILKEPVHGV, A*301-KIRLRPGGK, A*301-AIFQSSMTK, A*301-TVYYGVPVWK, B35-EPIVGAETF, B35-HPDIVIYQY, B35-PPIPVGEIY, B35-NSSKVSQNY, B35-VPLRPMTY, B35-DPNPQEVVL			
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK		human(B27)	[Culmann(1998)]
	• Optimal epitope mapped by peptide titration				
Nef(73–82)	Nef(73–82 LAI)	SVPLRPMTYK	HIV-1 infection	human(B35 or C4)	[Buseyne (1993)]
	• Vertical transmission of HIV ranges from 13% to 39% • Primary assays showed cytotoxic activity against at least one HIV protein was detected in 70% of infected children • Epitopes recognized in £ve children were mapped using synthetic peptides and secondary cultures • Patient EM13, who had a CTL response to three epitopes in Nef, was infected via blood transfusion after birth and went from CDC stage P2A to P2E during the study				
Nef(74–81)	Nef(74–82)	VPLRPMTY		human(A3)	[Carreno (1992)]
	• Included in HLA-A3 binding peptide competition study				
Nef(74–81)	Nef(73–82 LAI)	VPLRPMTY	HIV-1 or HIV-2 infection	human(B*3501)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*3501 epitope				
Nef(74–81)	Nef(75–82)	VPLRPMTY	no CTL shown	human(B*3501)	[Smith (1996)]
	• Crystal structure of VPLRPMTY-class I B allele HLA-B*3501 complex				
Nef(74–81)	Nef(73–82 LAI)	VPLRPMTY	HIV-1 or HIV-2 infection	human(B35)	[McMichael & Walker(1994), Culmann (1991)]
	• Review of HIV CTL epitopes – de£ned by B35 motif found within a larger peptide				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(74–81)	Nef(73–82 LAI)	VPLRPMTY	HIV-1 or -2 infection	human(B35)	[Rowland-Jones (1995)]
	• VPLRPMTY also recognized by CTL from HIV-2 seropositives; epitope is conserved				
Nef(74–81)	Nef()	VPLRPMTY	HIV-1 exposure	human(B35)	[Rowland-Jones (1998a)]
	• A CTL response was found in exposed but uninfected prostitutes from Nairobi using previously-de£ned B clade epitopes that tended to be conserved in A and D clades – such cross-reactivity could protect against both A and D and confer protection in Nairobi where both subtypes are circulating • The A and D subtype consensus are identical to the B clade epitope				
Nef(74–81)	Nef(75–82)	VPLRPMTY	none	human(B35)	[Lalvani (1997)]
	• A peptide-based protocol was optimized for restimulation of CTLp using optimized peptide and IL-7 concentrations – importantly this protocol does not stimulate a primary response, only secondary – peptide-speci£c CTLp counts could be obtained via staining with peptide-Class I tetramers • This peptide was one of the B35 presented test peptides used in control experiments showing that the assay gave no activity using lymphocytes from 21 healthy B35 seronegative donors				
Nef(74–81)	Nef()	VPLRPMTY	HIV-1 exposure	human(B35)	[Rowland-Jones (1998b)]
	• HIV-speci£c CTL were found in exposed seronegative prostitutes from Nairobi – these CTL may confer protection • Seroprevalence in this cohort is 90-95% and their HIV-1 exposure is among the highest in the world • Most isolated HIV strains are clade A in Nairobi, although clades C and D are also found – B clade epitopes are often cross-reactive, however stronger responses are frequently observed using A or D clade versions of epitopes • This epitope is conserved among A, B, and D clade viruses				
Nef(74–81)	Nef()	VPLRPMTY		human(B35)	[Rowland-Jones (1999)]
	• CTL responses in seronegative highly HIV-exposed African female sex workers in Gambia and Nairobi were studied – these women had no delta 32 deletion in CCR5 • In Gambia there is exposure to both HIV-1 and HIV-2, CTL responses to B35 epitopes in exposed, uninfected women are cross-reactive, • HIV-2 version of this epitope is conserved: VPLRPMTY, and CTLs are cross-reactive – one of £ve B35 CTL epitopes that are cross-reactive, see also [Rowland-Jones (1995)]				
Nef(74–82)	Nef(73–82)	VPLRPMTYK	no CTL shown	human(A11)	[Zhang (1993)]
	• Exploration of A11 binding motif				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(75–82)	Nef(75–82 LAI)	PLRPMTYK	HIV-1 infection	human(A*1101)	[McMichael & Walker(1994)]
	• Review of HIV CTL epitopes • C. Brander notes that this is an A*1101 epitope in the 1999 database				
Nef(75–82)	Nef(75–82 LAI)	PLRPMTYK	HIV-1 infection	human(A*1101)	[Brander & Goulder(2001)]
	• C. Brander notes this is an A*1101 epitope				
Nef(77–85)	Nef(77–85 LAI)	RPMTYKAAL	HIV-1 infection	human(B*0702)	[Bauer (1997)]
	• Structural constraints on the Nef protein may prevent escape • Noted in Brander 1999, this database, to be B*0702				
Nef(77–85)	Nef(77–85 LAI)	RPMTYKAAL	HIV-1 infection	human(B*0702)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*0702 epitope				
Nef(82–91)	Nef(82–91 LAI)	KAAVDLSHFL	HIV-1 infection	human(C*0802)	[Nixon (1999)]
	• A patient who made a mono-speci£c CTL response to this Nef speci£c epitope was given effective anti-retroviral therapy within 90 days of infection, reducing the antigenic stimulous • Within 7 days of therapy, his CTLp frequency dropped from 60 to 4 per million PBMC, as his viremia dropped • The patient went from having an activated effector population (detected by CTLp and clone speci£c RNA) to a non-activated quiescent population (detected by the CTL-clone speci£c DNA)				
Nef(82–91)	Nef(82–91 LAI)	KAAVDLSHFL	HIV-1 infection	human(C*0802(Cw8))	[Brander & Goulder(2001)]
	• C. Brander notes this is a C*0802(Cw8) epitope				
Nef(84–91)	Nef(84–91 LAI)	AVDLSHFL	HIV-1 infection	human(Bw62)	[Culmann-Penciolelli (1994)]
Nef(84–91)	Nef(84–91)	AVDLSHFL	HIV-1 infection	human(Bw62)	[Betts (2000)]
	• Only 4/11 HLA-A2+ HIV+ individuals had CTL that reacted to SLYNTVATL, calling into question whether it is immunodominant • Ninty £ve optimally de£ned peptides from this database were used to screen for gamma interferon responses to other epitopes • 1/11 of the A2+ individuals that didn„t respond to SLYNTVATL reacted with seven other epitopes including this epitope				

Table 11: **All De£ned Epitopes within the 20mer, regardless of HLA type**

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(72–79)	Nef()	VPLRPMTY	HIV-1 exposed seronegative	human(B35)	[Kaul (2000)]
	• 11/16 heavily HIV exposed but persistently seronegative sex-workers in Nairobi had HIV-speci£c CD8 gamma-IFN responses in the cervix – systemic CD8+ T cell responses tended to be to the same epitopes but at generally lower levels than cervical CD8+ T cell responses • Low risk individuals did not have such CD8+ cells • CD8+ epitopes T cell DTVLEDINL (3 individuals), SLYNVATL (4 individuals), LSPRTLNAW (3 individuals) and YPLTFGWCF (4 individuals) were most commonly recognized by the HIV-resistant women				
Nef(72–79)	Nef()	VPLRPMTY	HIV-1 infection	human(B35)	[Wilson (2000)]
	• Three individuals with highly focused HIV-speci£c CTL responses were studied during acute infection using tetramers – high frequencies of HIV-1-speci£c CD8+ T cells were found prior to seroconversion, and there was a close temporal relationship between the number of circulating HIV-speci£c T cells and viral load was also found • All three patients were B*2705, with HLA alleles: A1, A30/31, B*2705, B35; A1, A*0301, B7, B2705; and A*0201, A*0301, B2705, B39 • ELISPOT was used to test a panel of CTL epitopes that had been de£ned earlier and were appropriate for the HLA haplotypes of the study subjects – 3/3 subjects showed a dominant response to the B*2705 epitope KRWIILGGLNK • The subject with A*0201 had a moderatly strong response to SLYNTVATL • Weak responses were observed to A*301-RLRPGGKKK, A*301-QVPLRPMTYK, and B7-TPGPGVRYPL in the subject who was HLA A1, A*0301, B7, B*2705 • No acute response was detected to the following epitopes: A*201-ILKEPVHGV, A*301-KIRLRPGGK, A*301-AIFQSSMTK, A*301-TVYYGVPVWK, B35-EPIVGAETF, B35-HPDIVIYQY, B35-PPIPVGEIY, B35-NSSKVSQNY, B35-VPLRPMTY, B35-DPNPQEVVL			
Nef(72–91)	Nef(71–90 SF2)	PQVPLRMTYKAAVDLSHFL	HIV-1 infection	human()	[Lieberman (1997a)]
	• Of 25 patients, most had CTL speci£c for more than 1 HIV-1 protein • Eleven subjects had CTL that could recognize vaccinia-expressed LAI Nef • Three of these 11 had CTL response to this peptide • The responding subjects were HLA-A3, A32, B51, B62; HLA-A11, A24, B8, B53				
Nef(72–91)	Nef(71–90 SF2)	PQVPLRPMTYKAAVDLSHFL	HIV-1 infection	human()	[Lieberman (1997b)]
	• CTL expanded *ex vivo* were later infused into HIV-1 infected patients				
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV infection	human()	[Garcia (1997)]
	• The anti-Nef CTL line P1 speci£c for this epitope is able to kill target cells via two mechanisms • First: Ca^{2+}-dependent, perforin-dependent Nef-speci£c lysis • Second: Ca^{2+}-independent, CD95-dependent apoptosis that could also kill non-speci£c targets • Findings indicate that the two mechanisms are not mutually exclusive in human CTL, as they are in mice • CTL mediated CD95-dependent apoptosis may play a role in pathogenesis				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(73–82)	Nef(73–82 NL43)	QVPLRPMTYK	HIV-1 infection	human(A*0301)	[Koenig (1990)]
	• 81 Tyr is critical for binding to A3.1 • C. Brander notes that this is an A*0301 epitope in the 1999 database				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK		human(A*0301)	[Brander & Goulder(2001)]
	• C. Brander notes this is an A*0301 epitope				
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(A11)	[Le Borgne (2000)]
	• Soluble factors in supernatant from both an HIV-speci£c cloned CTL line and an EBV (Epstein-Barr-virus) CTL line inhibit viral replication, but do not block viral entry in CD4+ T lymphocytes, by a noncytotoxic mechanism				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A11)	[Robertson (1993)]
	• Development of a retroviral vector (pNeoNef) to generate autologous CTL targets • [Hunziker (1998)] suggests that HLA-A2 does not in fact present this epitope • The initial assignment of HLA-A2 presentation for this epitope was based on a serological HLA typing. Subsequently, the authors revisited the issue with genetic HLA typing and found that HLA-A11 was the correct presenting molecule (Dr. Florence Buseyne, Pers. Comm., 2000)				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A11)	[Couillin (1994), Goulder (1997a)]
	• Mutational variation in HIV epitopes in individuals with appropriate HLA types can result in evasion of CTL response • [Goulder (1997a)] is a review of immune escape that summarizes this study				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A11)	[Couillin (1995)]
	• Mutations found in this epitope in HLA-A11 positive and negative donors were characterized				
Nef(73–82)	()	QVPLRPMTYK		(A11)	[Brander & Goulder(2001), Buseyne(1999)]
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-infection	human(A3)	[Chassin (1999)]
	• Mutations in Nef that ¤ank this epitope, Thr71Lys and Ala83Gly, may account for an observed loss of CTL reactivity, with escape due to the introduction of proteasome processing defects				

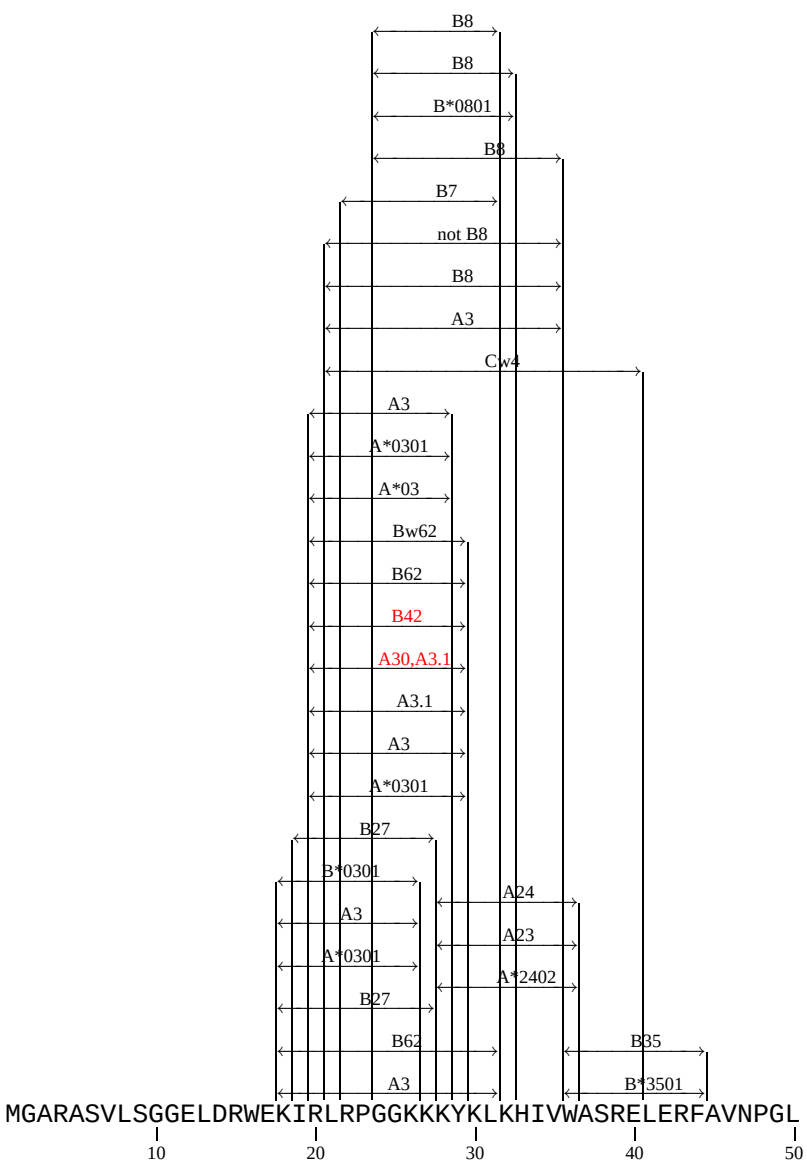
HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(A3)	[Durali (1998)]
	• Cross-clade CTL response was studied by determining the CTL activity in seven patients from Bangui, (6 A subtype, and 1 AG recombinant infections) and one A subtype infection from a person living in France originally from Togo, to different antigens expressed in vaccinia • Pol reactivity: 8/8 had CTL to A subtype, and 7/8 to B subtype, and HIV-2 Pol was not tested • Gag reactivity: 7/8 reacted with A or B subtype gag, 3/8 with HIV-2 Gag • Nef reactivity: 7/8 reacted with A subtype, and 5/8 with B subtype, none with HIV-2 Nef • Env reactivity: 3/8 reacted with A subtype, 1/8 with B subtype, none with HIV-2 Env • One of the patients was shown to react to this epitope: QVPLRPMTYK			
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A3)	[Goulder (1997b), Goulder (1997a)]
	• Identical twin hemophiliac brothers were both infected with the same batch of factor VIII • Both had a response to this epitope • [Goulder (1997a)] is a review of immune escape that summarizes this study				
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(A3)	[Lubaki (1997)]
	• Eighty two HIV-1-speci£c CTL clones from 5 long-term non-progressors were isolated and analyzed for breadth of response • A sustained Gag, Env and Nef response was observed, and clones were restricted by multiple HLA epitopes, indicating a polyclonal response • An A3+ subject had a strong response to this epitope, with 10/11 CTL clones being speci£c for this epitope, isolated at two time points, 1 year apart				
Nef(73–82)	Nef(73–82 BRU)	QVPLRPMTYK	HIV-1 infection	human(A3, A11, B35)	[Culmann (1991)]
	• Nef CTL clones from HIV+ donors				
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK	HIV-1 infection	human(A3.1)	[Koenig (1995)]
	• Alanine substitutions L76A, R77A, M79A, T80A signi£cantly decreased immunogenicity of peptide • Nef CTL clones (4N225) were infused into an HIV-1 infected volunteer to evaluate effects of infusion on viral load/patient health • Infusion led to outburst of escape variants which resulted in higher viral load/accelerated disease progression				
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(A3.1)	[Betts (2000)]
	• Only 4/11 HLA-A2+ HIV+ individuals had CTL that reacted to SLYNTVATL, calling into question whether it is immunodominant • Ninty £ve optimally de£ned peptides from this database were used to screen for gamma interferon responses to other epitopes • 1/11 of the A2+ individuals was A3, and responded to QVPLRPMTYK as well as two other A3.1 epitopes				

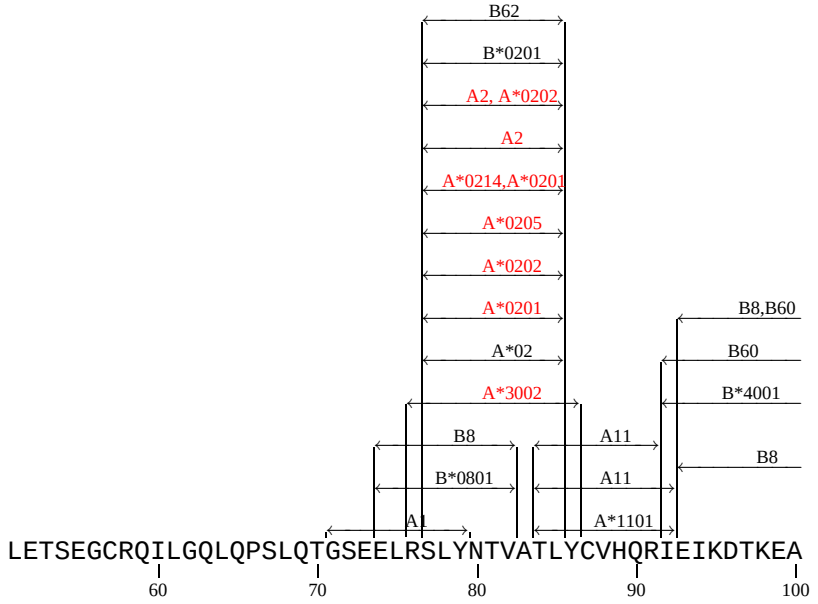
HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(73–82)	Nef(73–82)	QVPLRPMTYK	HIV-1 infection	human(B*0301)	[Wilson (2000)]
	• Three individuals with highly focused HIV-speci£c CTL responses were studied during acute infection using tetramers – high frequencies of HIV-1-speci£c CD8+ T cells were found prior to seroconversion, and there was a close temporal relationship between the number of circulating HIV-speci£c T cells and viral load was also found • All three patients were B*2705, with HLA alleles: A1, A30/31, B*2705, B35; A1, A*0301, B7, B2705; and A*0201, A*0301, B2705, B39 • ELISPOT was used to test a panel of CTL epitopes that had been de£ned earlier and were appropriate for the HLA haplotypes of the study subjects – 3/3 subjects showed a dominant response to the B*2705 epitope KRWIILGGLNK • The subject with A*0201 had a moderatly strong response to SLYNTVATL • Weak responses were observed to A*301-RLRPGGKKK, A*301-QVPLRPMTYK, and B7-TPGPGVRYPL in the subject who was HLA A1, A*0301, B7, B*2705 • No acute response was detected to the following epitopes: A*201-ILKEPVHGV, A*301-KIRLRPGGK, A*301-AIFQSSMTK, A*301-TVYYGVPVWK, B35-EPIVGAETF, B35-HPDIVIYQY, B35-PPIPVGEIY, B35-NSSKVSQNY, B35-VPLRPMTY, B35-DPNPQEVVL			
Nef(73–82)	Nef(73–82 LAI)	QVPLRPMTYK		human(B27)	[Culmann(1998)]
	• Optimal epitope mapped by peptide titration				
Nef(73–82)	Nef(73–82 LAI)	SVPLRPMTYK	HIV-1 infection	human(B35 or C4)	[Buseyne (1993)]
	• Vertical transmission of HIV ranges from 13% to 39% • Primary assays showed cytotoxic activity against at least one HIV protein was detected in 70% of infected children • Epitopes recognized in £ve children were mapped using synthetic peptides and secondary cultures • Patient EM13, who had a CTL response to three epitopes in Nef, was infected via blood transfusion after birth and went from CDC stage P2A to P2E during the study				
Nef(74–81)	Nef(74–82)	VPLRPMTY		human(A3)	[Carreno (1992)]
	• Included in HLA-A3 binding peptide competition study				
Nef(74–81)	Nef(73–82 LAI)	VPLRPMTY	HIV-1 or HIV-2 infection	human(B*3501)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*3501 epitope				
Nef(74–81)	Nef(75–82)	VPLRPMTY	no CTL shown	human(B*3501)	[Smith (1996)]
	• Crystal structure of VPLRPMTY-class I B allele HLA-B*3501 complex				
Nef(74–81)	Nef(73–82 LAI)	VPLRPMTY	HIV-1 or HIV-2 infection	human(B35)	[McMichael & Walker(1994), Culmann (1991)]
	• Review of HIV CTL epitopes – de£ned by B35 motif found within a larger peptide				

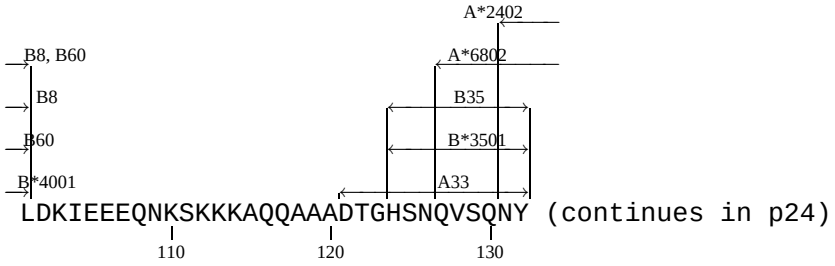
HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(74–81)	Nef(73–82 LAI)	VPLRPMTY	HIV-1 or -2 infection	human(B35)	[Rowland-Jones (1995)]
	• VPLRPMTY also recognized by CTL from HIV-2 seropositives; epitope is conserved				
Nef(74–81)	Nef()	VPLRPMTY	HIV-1 exposure	human(B35)	[Rowland-Jones (1998a)]
	• A CTL response was found in exposed but uninfected prostitutes from Nairobi using previously-de£ned B clade epitopes that tended to be conserved in A and D clades – such cross-reactivity could protect against both A and D and confer protection in Nairobi where both subtypes are circulating • The A and D subtype consensus are identical to the B clade epitope				
Nef(74–81)	Nef(75–82)	VPLRPMTY	none	human(B35)	[Lalvani (1997)]
	• A peptide-based protocol was optimized for restimulation of CTLp using optimized peptide and IL-7 concentrations – importantly this protocol does not stimulate a primary response, only secondary – peptide-speci£c CTLp counts could be obtained via staining with peptide-Class I tetramers • This peptide was one of the B35 presented test peptides used in control experiments showing that the assay gave no activity using lymphocytes from 21 healthy B35 seronegative donors				
Nef(74–81)	Nef()	VPLRPMTY	HIV-1 exposure	human(B35)	[Rowland-Jones (1998b)]
	• HIV-speci£c CTL were found in exposed seronegative prostitutes from Nairobi – these CTL may confer protection • Seroprevalence in this cohort is 90-95% and their HIV-1 exposure is among the highest in the world • Most isolated HIV strains are clade A in Nairobi, although clades C and D are also found – B clade epitopes are often cross-reactive, however stronger responses are frequently observed using A or D clade versions of epitopes • This epitope is conserved among A, B, and D clade viruses				
Nef(74–81)	Nef()	VPLRPMTY		human(B35)	[Rowland-Jones (1999)]
	• CTL responses in seronegative highly HIV-exposed African female sex workers in Gambia and Nairobi were studied – these women had no delta 32 deletion in CCR5 • In Gambia there is exposure to both HIV-1 and HIV-2, CTL responses to B35 epitopes in exposed, uninfected women are cross-reactive, • HIV-2 version of this epitope is conserved: VPLRPMTY, and CTLs are cross-reactive – one of £ve B35 CTL epitopes that are cross-reactive, see also [Rowland-Jones (1995)]				
Nef(74–82)	Nef(73–82)	VPLRPMTYK	no CTL shown	human(A11)	[Zhang (1993)]
	• Exploration of A11 binding motif				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
Nef(75–82)	Nef(75–82 LAI)	PLRPMTYK	HIV-1 infection	human(A*1101)	[McMichael & Walker(1994)]
	• Review of HIV CTL epitopes • C. Brander notes that this is an A*1101 epitope in the 1999 database				
Nef(75–82)	Nef(75–82 LAI)	PLRPMTYK	HIV-1 infection	human(A*1101)	[Brander & Goulder(2001)]
	• C. Brander notes this is an A*1101 epitope				
Nef(77–85)	Nef(77–85 LAI)	RPMTYKAAL	HIV-1 infection	human(B*0702)	[Bauer (1997)]
	• Structural constraints on the Nef protein may prevent escape • Noted in Brander 1999, this database, to be B*0702				
Nef(77–85)	Nef(77–85 LAI)	RPMTYKAAL	HIV-1 infection	human(B*0702)	[Brander & Goulder(2001)]
	• C. Brander notes this is a B*0702 epitope				
Nef(82–91)	Nef(82–91 LAI)	KAAVDLSHFL	HIV-1 infection	human(C*0802)	[Nixon (1999)]
	• A patient who made a mono-speci£c CTL response to this Nef speci£c epitope was given effective anti-retroviral therapy within 90 days of infection, reducing the antigenic stimulous • Within 7 days of therapy, his CTLp frequency dropped from 60 to 4 per million PBMC, as his viremia dropped • The patient went from having an activated effector population (detected by CTLp and clone speci£c RNA) to a non-activated quiescent population (detected by the CTL-clone speci£c DNA)				
Nef(82–91)	Nef(82–91 LAI)	KAAVDLSHFL	HIV-1 infection	human(C*0802(Cw8))	[Brander & Goulder(2001)]
	• C. Brander notes this is a C*0802(Cw8) epitope				
Nef(84–91)	Nef(84–91 LAI)	AVDLSHFL	HIV-1 infection	human(Bw62)	[Culmann-Penciolelli (1994)]
Nef(84–91)	Nef(84–91)	AVDLSHFL	HIV-1 infection	human(Bw62)	[Betts (2000)]
	• Only 4/11 HLA-A2+ HIV+ individuals had CTL that reacted to SLYNTVATL, calling into question whether it is immunodominant • Ninty £ve optimally de£ned peptides from this database were used to screen for gamma interferon responses to other epitopes • 1/11 of the A2+ individuals that didn„t respond to SLYNTVATL reacted with seven other epitopes including this epitope				

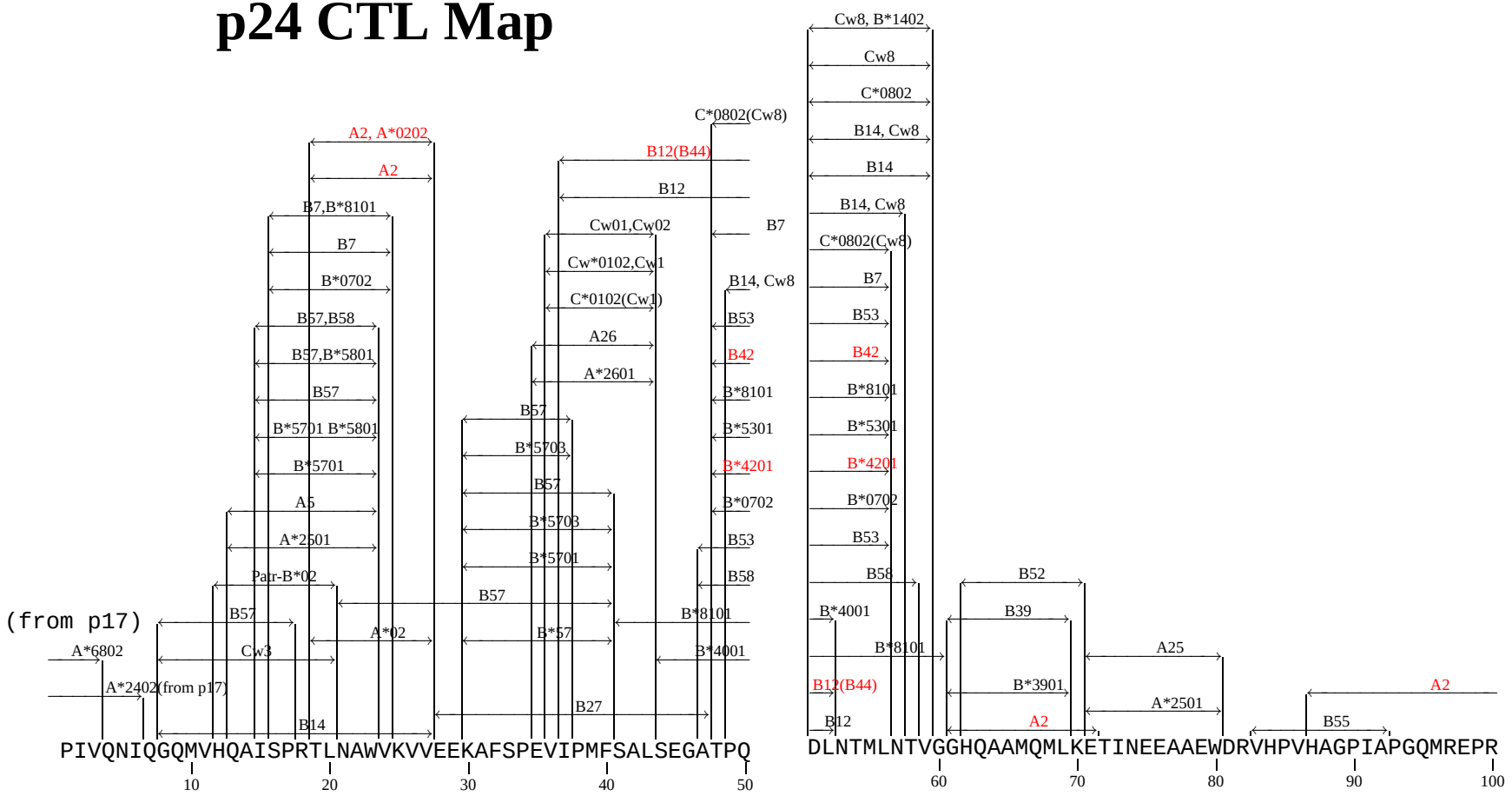
p17 CTL Map

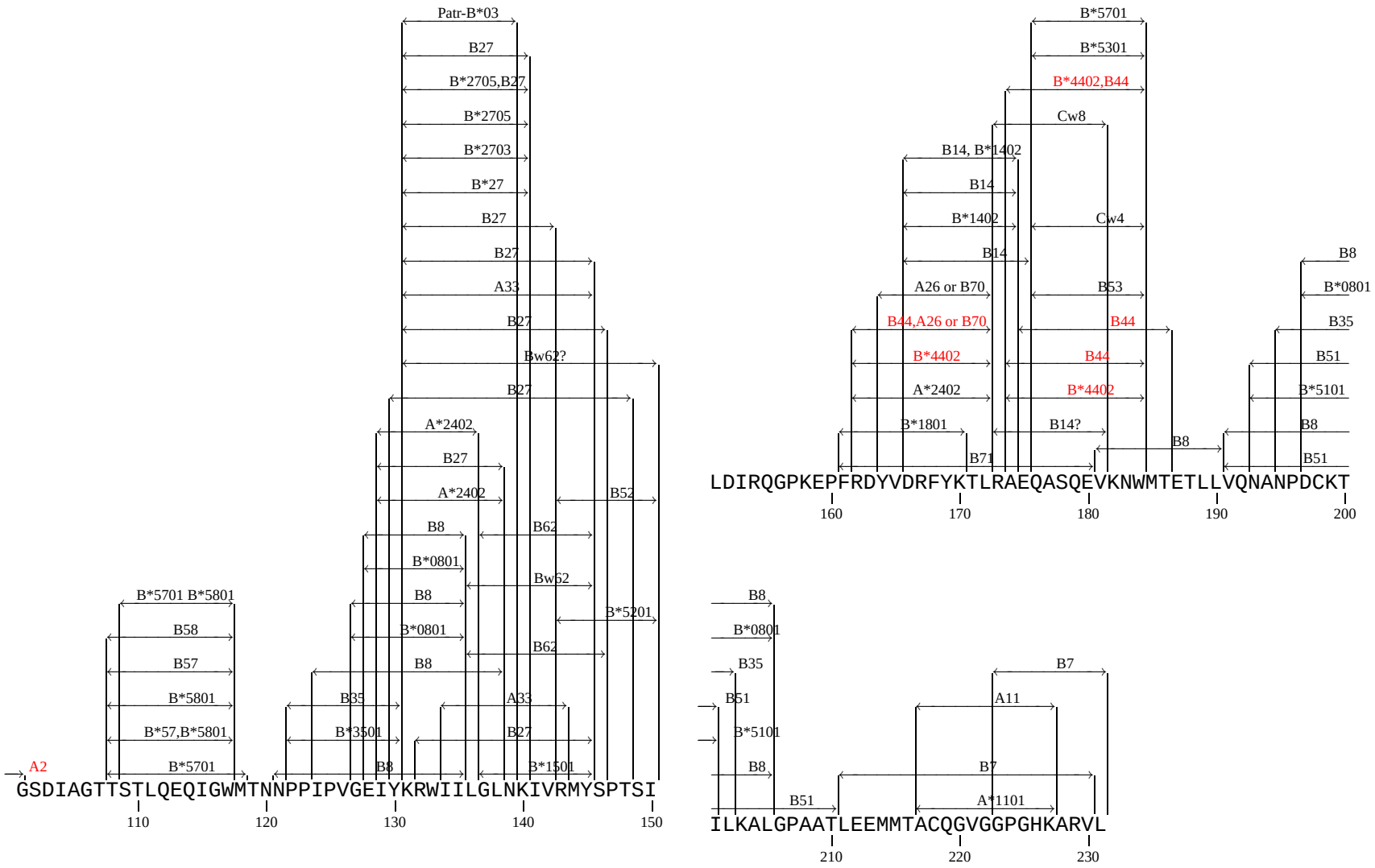

B8
B8
B*0801
B8
B7
not B8
B8
A3
Cw4
A3
A*0301
A*03
Bw62
B62
B42
A30,A3.1
A3.1
A3
A*0301
B27
B*0301
A3
A*0301
B27
B62
A3
A24
A23
A*2402
B35
B*3501
MGARASVLSGGELDRWEKIRLRPGGKKKYKLKHIVWASRELERFAVNPGL
10
20
30
40
50


B62
B*0201
A2, A*0202
A2
A*0214,A*0201
A*0205
A*0202
A*0201
A*02
A*3002
B8
B*0801
A1
A11
A11
A*1101
B8,B60
B60
B*4001
B8
LETSEGCRQILGQLQPSLQTGSEELRSLYNTVATLYCVHQRIEIKDTKEA
60
70
80
90
100

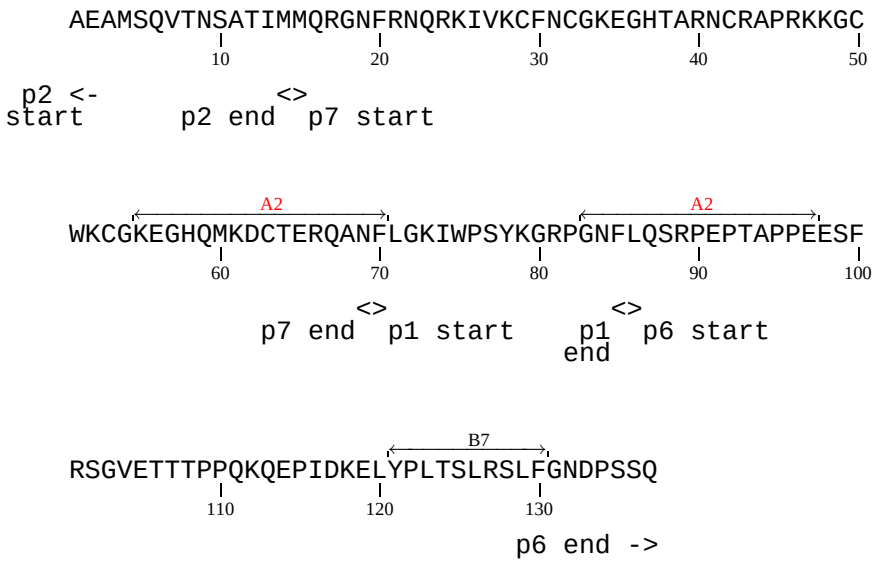

A*2402
A*6802
B35
B*3501
A33
B8, B60
B8
B60
B*4001
LDKIEEEQNKSKKKAQQAAADTGHSNQVSQNY (continues in p24)
110
120
130

p24 CTL Map

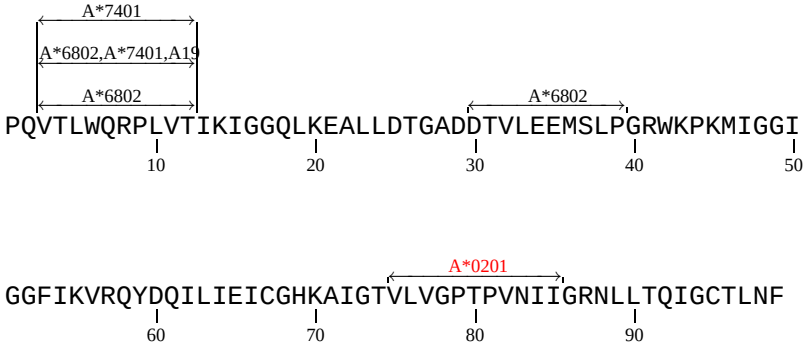

(from p17)
A*6802
A*2402(from p17)
A2, A*0202
A2
B7,B*8101
B7
B*0702
B57,B58
B57,B*5801
B57
B*5701 B*5801
B*5701
A5
A*2501
Pair-B*02
B57
A*02
Cw3
B14
C*0802(Cw8)
B12(B44)
B12
Cw01,Cw02
Cw*0102,Cw1
C*0102(Cw1)
A26
A*2601
B57
B*5703
B57
B*5703
B*5701
B57
B*8101
B27
B7
B14, Cw8
B53
B42
B*8101
B*5301
B*4201
B*0702
B53
B58
B*8101
B*4001
PIVQNIQGQMVHQAISPRTLNAWVKVVEEKAFSPEVIPMFSALSEGATPQ
10
20
30
40
50
Cw8, B*1402
Cw8
C*0802
B14, Cw8
B14
B14, Cw8
C*0802(Cw8)
B7
B53
B42
B*8101
B*5301
B*4201
B*0702
B53
B58
B*4001
B*8101
B12(B44)
B12
B52
B39
B*3901
A2
A25
A*2501
A2
B55
DLNTMLNTVGGHQAAMQMLKETINEEAAEWDRVHPVHAGPIAPGQMREPR
60
70
80
90
100


Patr-B*03
B27
B*2705,B27
B*2705
B*2703
B*27
B27
B27
A33
B27
Bw62?
B27
A*2402
B27
A*2402
B52
B8
B62
B*0801
Bw62
B*5701 B*5801
B8
B*5201
B58
B*0801
B62
B57
B8
B*5801
B35
A33
B*57,B*5801
B*3501
B27
A2
B*5701
B8
B*1501
GSDIAGTTSTLQEQIGWMTNNPPIPVGEIYKRWIILGLNKIVRMYSPTSI
110
120
130
140
150
B*5701
B*5301
B*4402,B44
Cw8
B14, B*1402
B14
B*1402
Cw4
B14
B8
A26 or B70
B53
B*0801
B44,A26 or B70
B44
B35
B*4402
B44
B51
A*2402
B*4402
B*5101
B*1801
B14?
B8
B8
B71
B51
LDIRQGPKEPFRDYVDRFYKTLRAEQASQEVKNWMTETLLVQNANPDCKT
160
170
180
190
200
B8
B*0801
B35
B51
B*5101
B8
B51
ILKALGPAATLEEMMTACQGVGGPGHKARVL
210
220
230
B7
A11
B7
A*1101

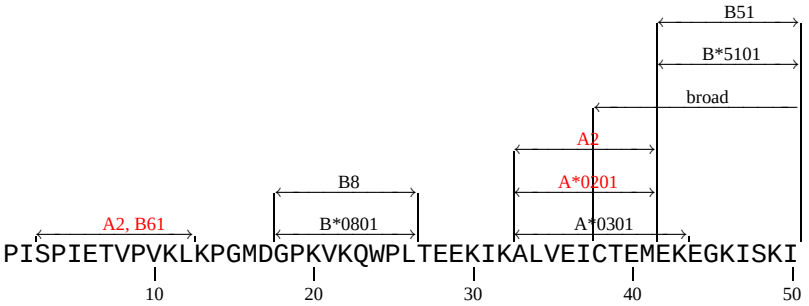
p2p7p1p6 CTL Map



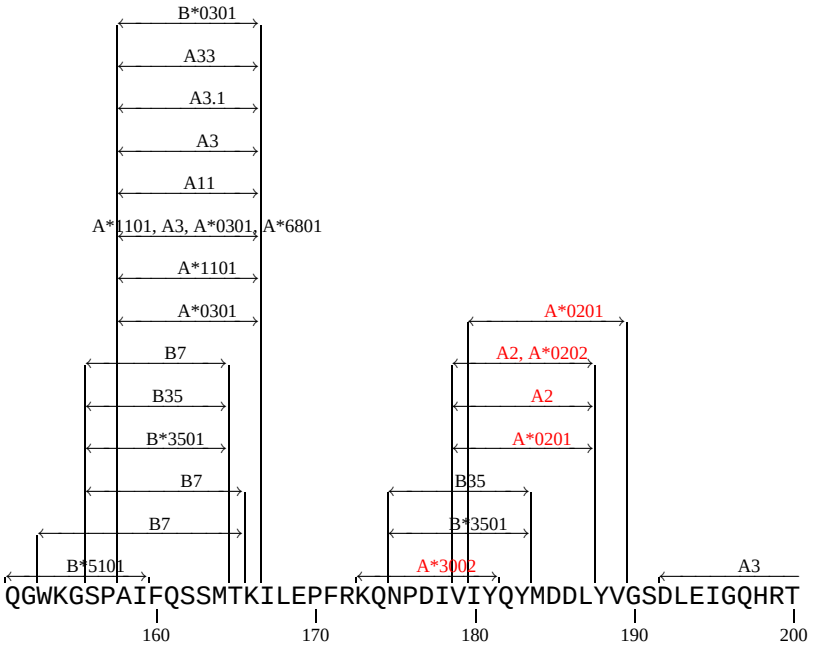
Protease CTL Map

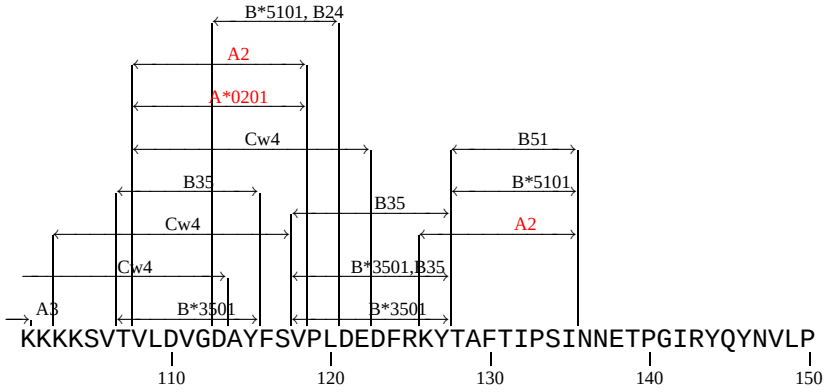


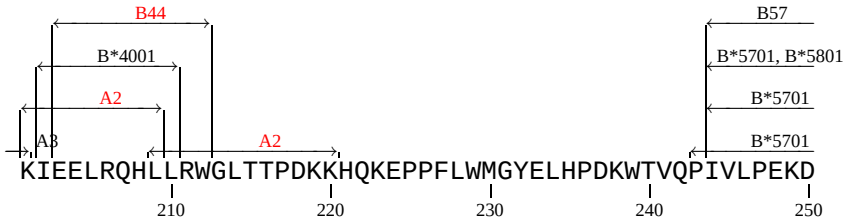
RT CTL Map

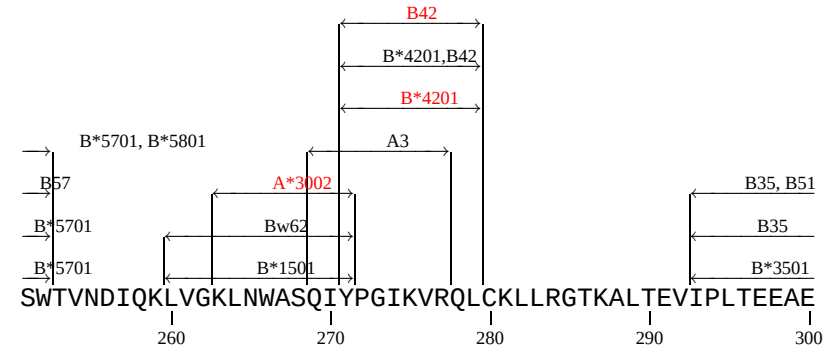

B51
B*5101
broad
A2
B8
A*0201
A2, B61
B*0801
A*0301
PISPIETVPVKLKPGMDGPKVKQWPLTEEKIKALVEICTEMEKEGKISKI
10
20
30
40
50

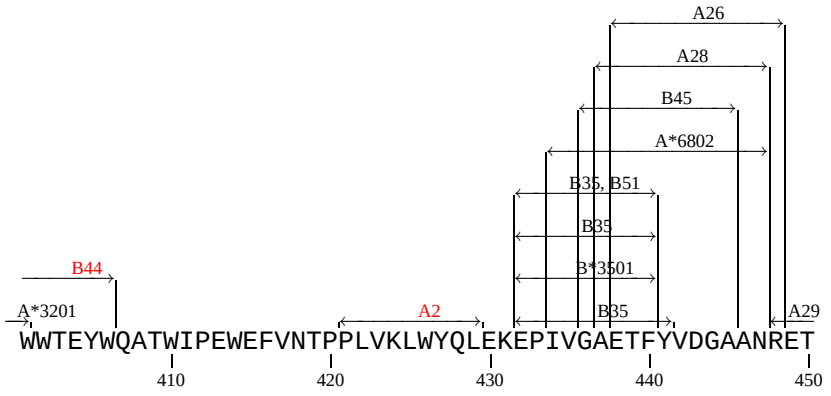

Cw4
broad
A3
GPENPYNTPVFAIKKKDSTKWRKLVDFRELNKRTQDFWEVQLGIPHPAGL
60
70
80
90
100


B*0301
A33
A3.1
A3
A11
A*1101, A3, A*0301, A*6801
A*1101
A*0301
B7
B35
B*3501
B7
B7
B*5101
A*0201
A2, A*0202
A2
A*0201
B35
B*3501
A*3002
A3
QGWKGSPAIFQSSMTKILEPFRKQNPDIVIYQYMDDLYVGSDLEIGQHRT
160
170
180
190
200

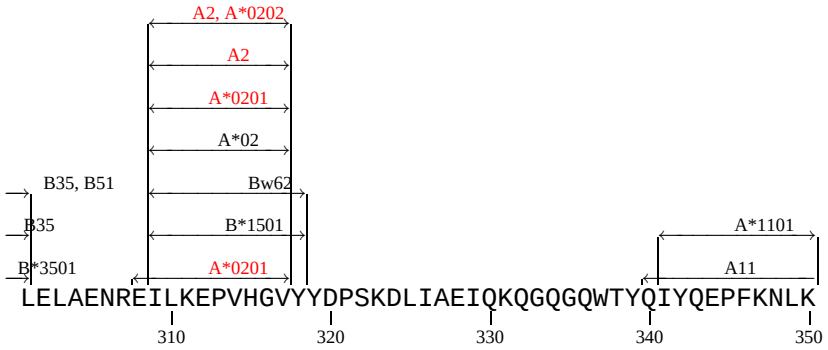

B*5101, B24
A2
A*0201
Cw4
B51
B35
B*5101
B35
Cw4
A2
Cw4
B*3501,B35
A3
B*3501
B*3501
KKKKSVTVLDVGDAYFSVPLDEDFRKYTAFTIPSINNETPGIRYQYNVLP
110
120
130
140
150

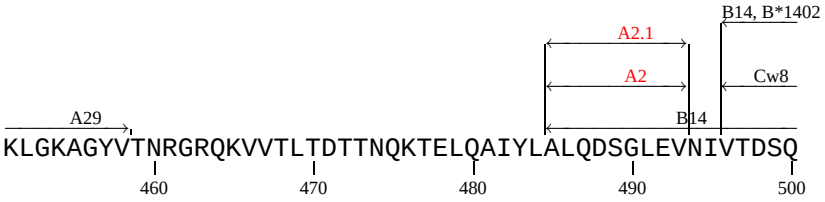

B44
B57
B*4001
B*5701, B*5801
A2
B*5701
A3
A2
B*5701
KIEELRQHLLRWGLTTPDKKHQKEPPFLWMGYELHPDKWTVQPIVLPEKD
210
220
230
240
250

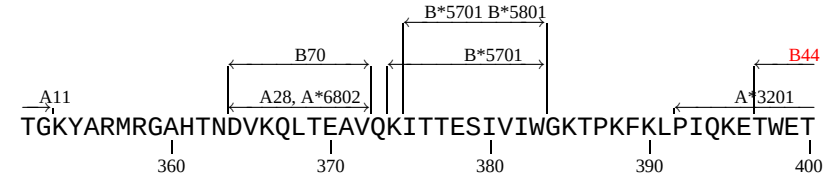


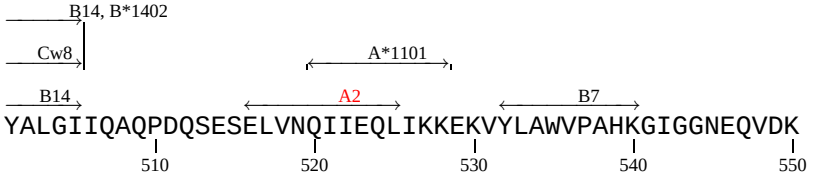


p15 RNase start <-





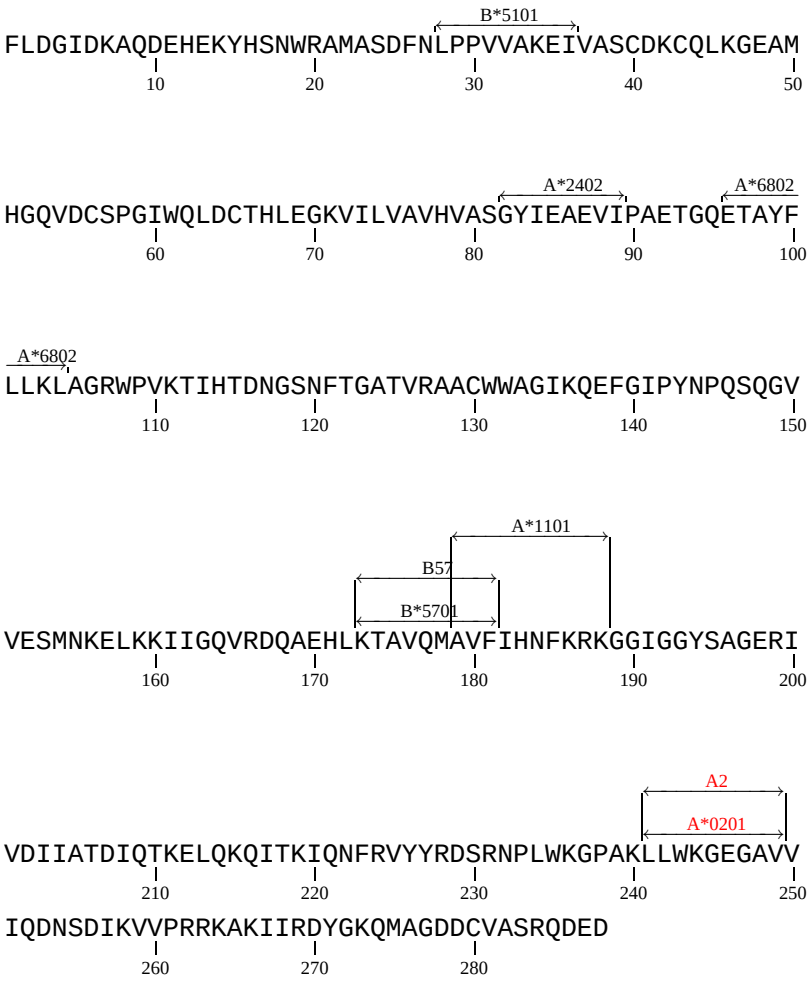




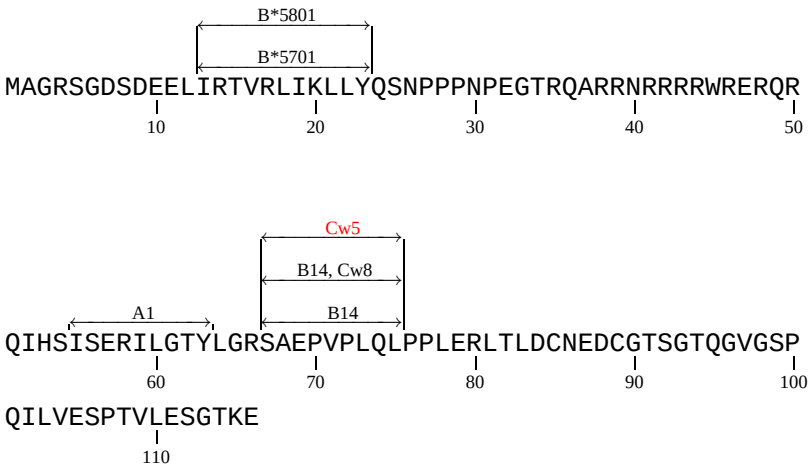
LVSAGIRKVL

-> p15 RNase end

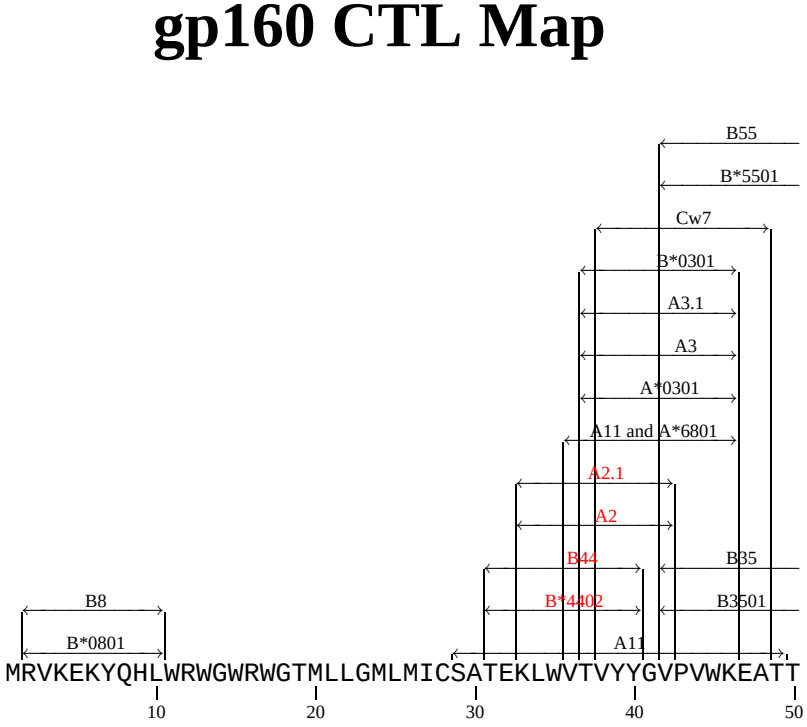
Integrase CTL Map



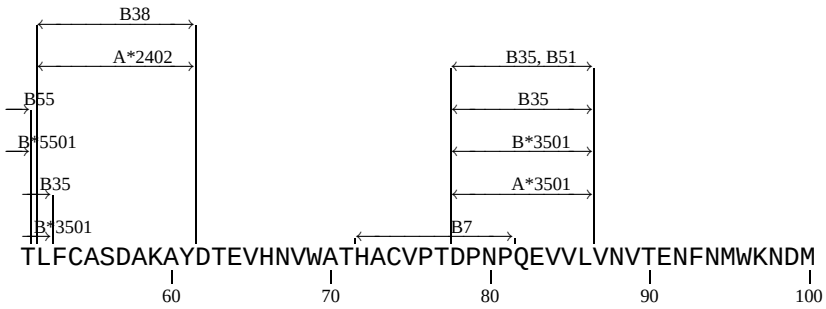
Rev CTL Map

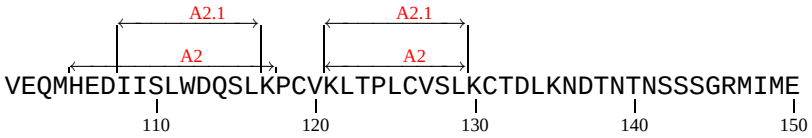


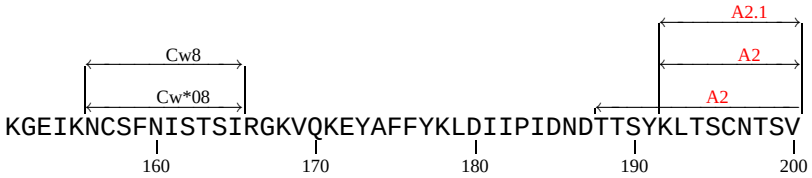
gp160 CTL Map

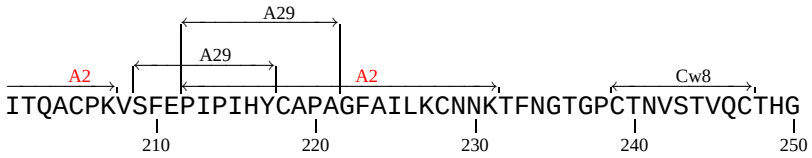


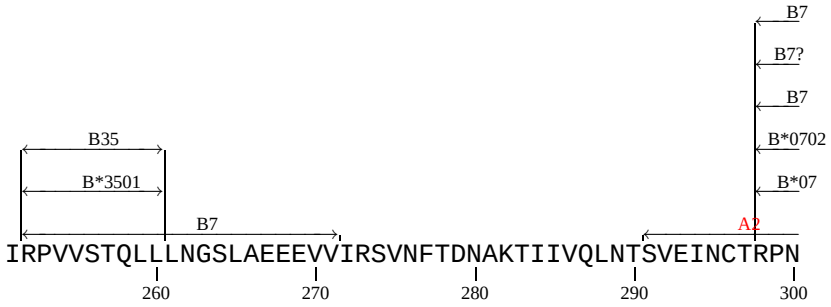
<- gp120 start

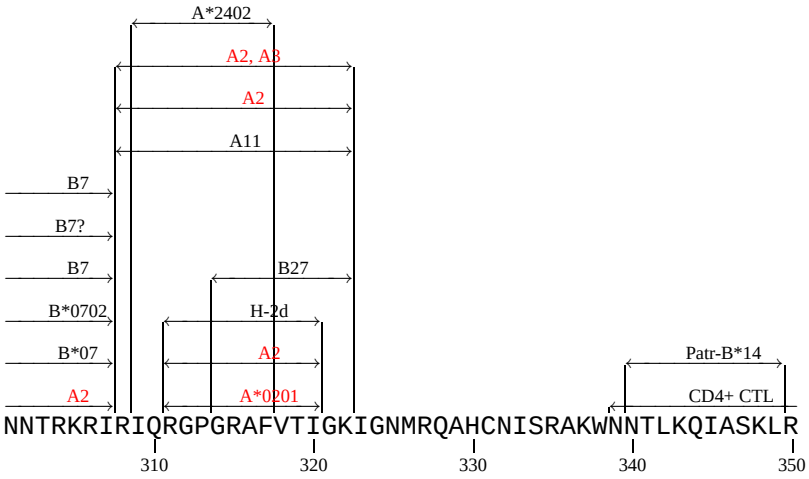


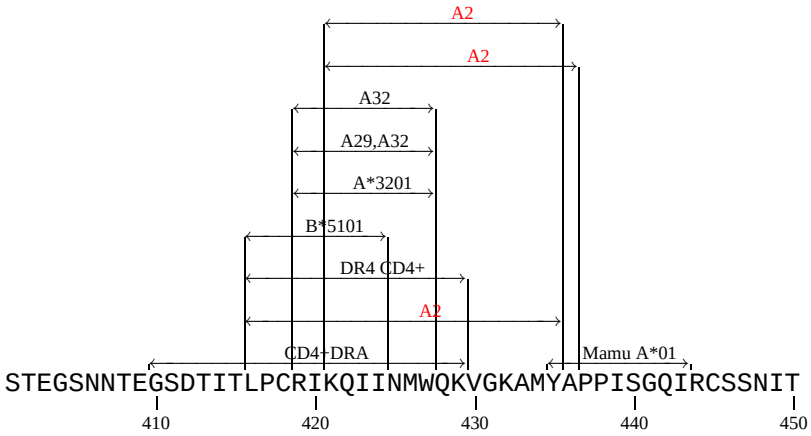


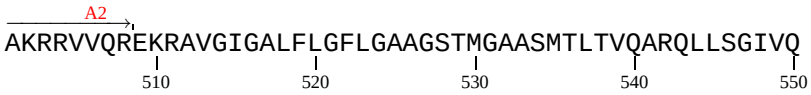




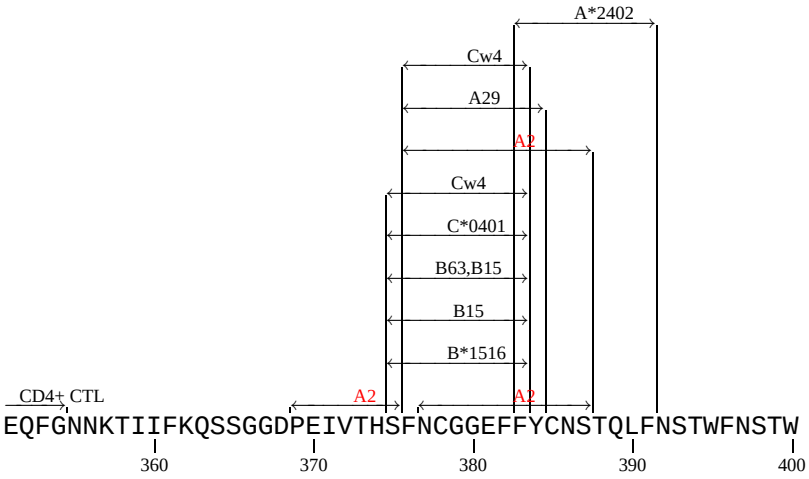


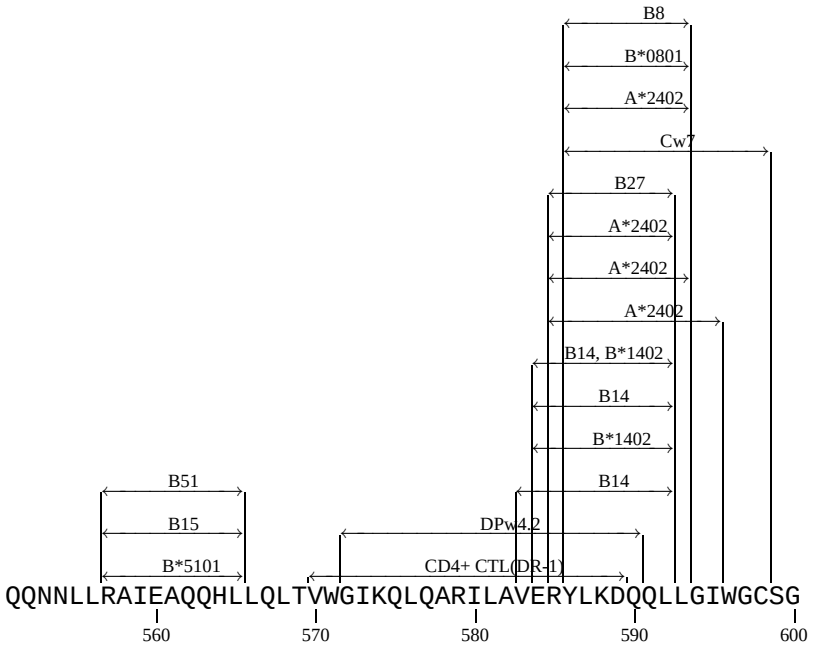


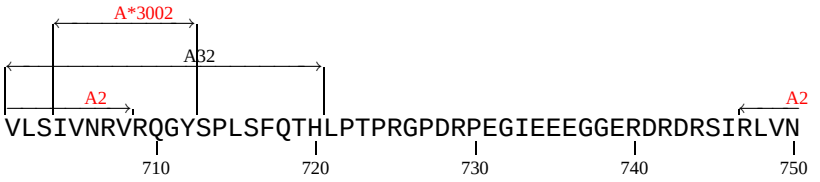


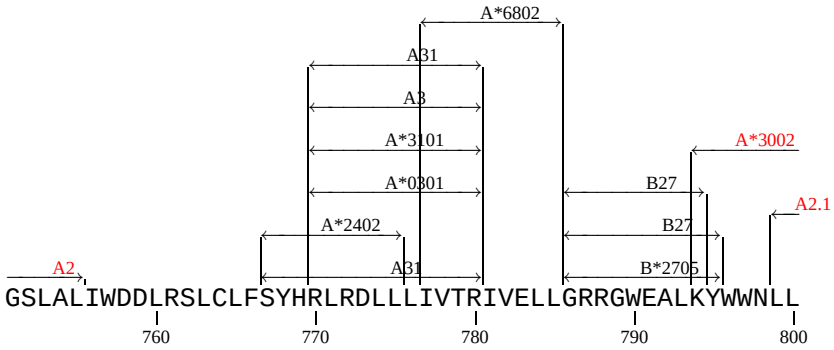


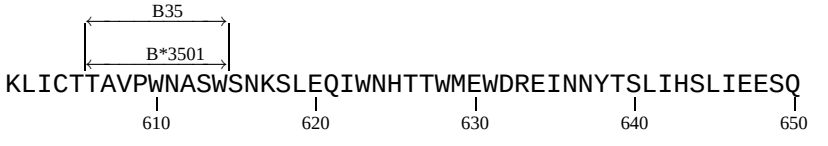
gp120 end <> gp41 start

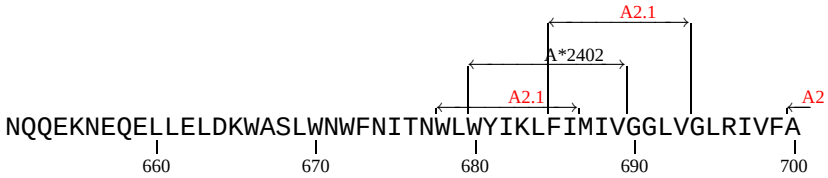


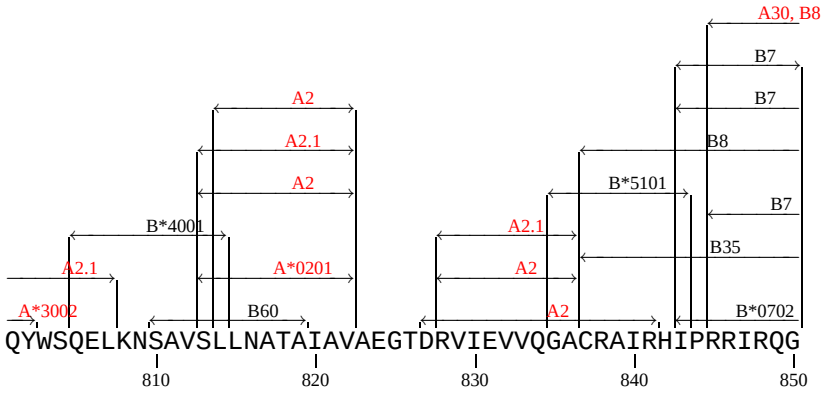

B8
B*0801
A*2402
Cw7
B27
A*2402
A*2402
A*2402
B14, B*1402
B14
B*1402
B14
B51
B15
B*5101
DPw4.2
CD4+ CTL(DR-1)
QQNNLLRAIEAQQHLLQLTVWGIKQLQARILAVERYLKDQQLLGIWGCSG
560
570
580
590
600

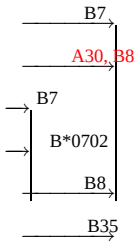

A*3002
A32
A2
A2
VLSIVNRVRQGYSPLSFQTHLPTPRGPDRPEGIEEEGGERDRDRSIRLVN
710
720
730
740
750


A*6802
A31
A3
A*3101
A*0301
A*2402
A31
A*3002
B27
B27
B*2705
A2.1
A2
GSLALIWDDLRSLCLFSYHRLRDLLLIVTRIVELLGRRGWEALKYWWNLL
760
770
780
790
800


B35
B*3501
KLICTTAVPWNASWSNKSLEQIWNHTTWMEWDREINNYTSLIHSLIEESQ
610
620
630
640
650


A2.1
A*2402
A2.1
A2
NQQEKNEQELLELDKWASLWNWFNITNWLWYIKLFIMIVGGLVGLRIVFA
660
670
680
690
700

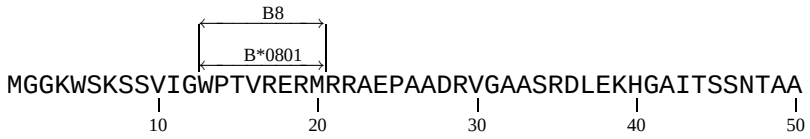

A30, B8
B7
B7
A2
A2.1
B8
A2
B*5101
B*4001
A2.1
B7
A2.1
B35
A*0201
A2
A*3002
B60
A2
B*0702
QYWSQELKNSAVSLLNATAIAVAEGTDRVIEVVQGACRAIRHIPRRIRQG
810
820
830
840
850

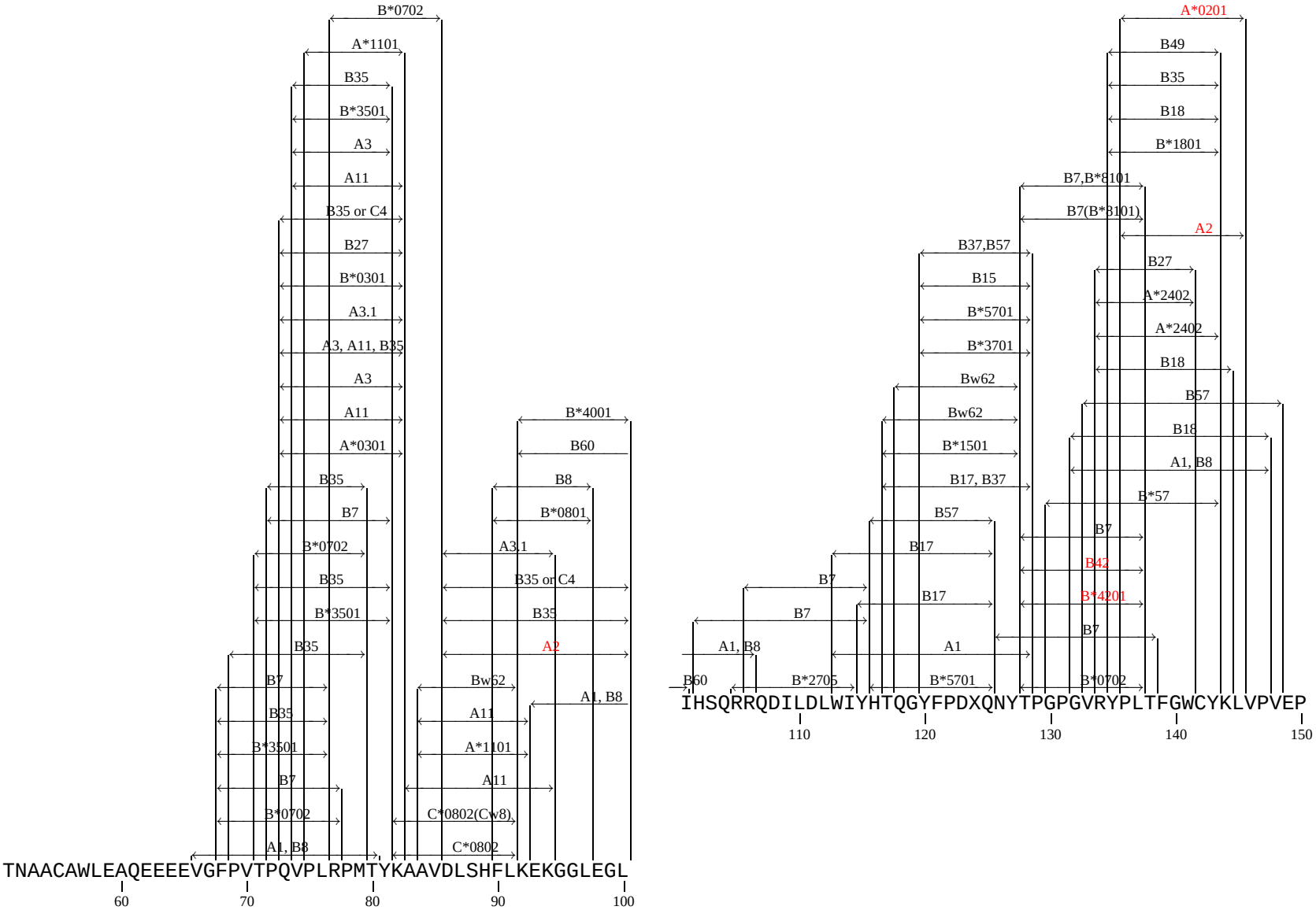


LERILL

-> gp41 end

Nef CTL Map




B*0702
A*1101
B35
B*3501
A3
A11
B35 or C4
B27
B*0301
A3.1
A3, A11, B35
A3
A11
A*0301
B35
B7
B*0702
B35
B*3501
B35
B7
A1, B8
B35
B*3501
B7
B*0702
A1, B8
B*4001
B60
B8
B*0801
A3.1
B35 or C4
B35
A2
Bw62
A1, B8
A11
A*1101
A11
C*0802(Cw8)
C*0802
TNAACAWLEAQEEEEVGFPVTPQVPLRPMTYKAAVDLSHFLKEKGGLEGL
60
70
80
90
100
A*0201
B49
B35
B18
B*1801
B7,B*8101
B7(B*8101)
A2
B37,B57
B27
B15
A*2402
B*5701
A*2402
B*3701
B18
Bw62
B57
Bw62
B18
B*1501
A1, B8
B17, B37
B*57
B57
B7
B17
B42
B7
B17
B*4201
B7
B7
A1, B8
A1
B60
B*2705
B*5701
B*0702
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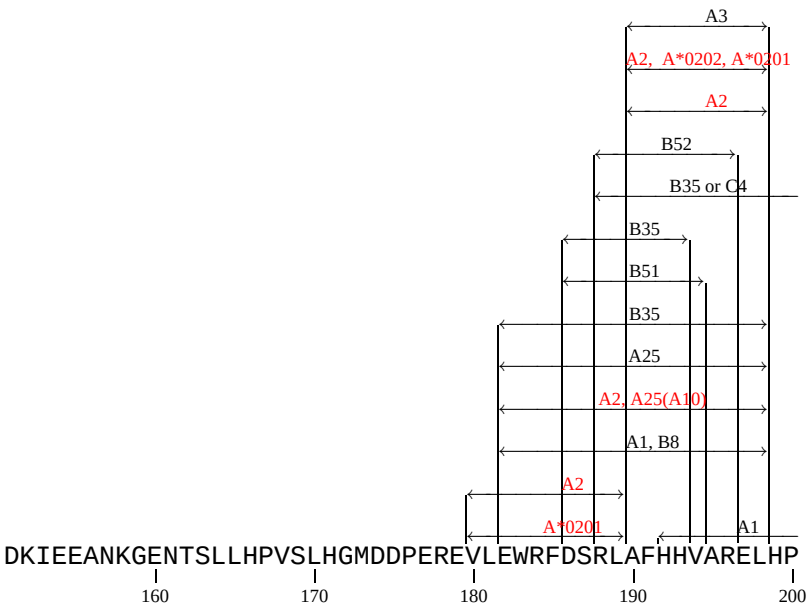
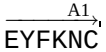
110
120
130
140
150





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